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THE PRESIDENT'S SCIENCE ADVISORY COMMITTEE

Executive Office Building
Washington 25, D. C.

REPORT

by the

PSAC PANEL ON CIVIL DEFENSE

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REPORT OF THE PSAC PANEL ON CIVIL DEFENSE

TABLE OF CONTENTS

3a

Page

3a

3a

PartVI (Cont'd) Page

3a

LIST OF TABLES AND FIGURES

Figure (Cont'd)

Table

Table (Cont'd) | | Page

SECRET
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We have profited from the input of a Sub-Panel on Technology for Shelter Survey, under the Chairmanship of Dr. Walter Zinn, and are looking forward to the results of the Sub-Panel on the Effects of Fire, under the Chairmanship of Professor H. C. Hottel, whose work is still in progress.

* Dr. Zinn was a former Member and Chairman. However, he did not participate in the preparation of this Report nor has he had an opportunity to review it.

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I. INTRODUCTION

A. Scope of Civil Defense in the Nuclear Age

The revolution in warfare that has followed upon the discovery of the release of nuclear energy can be roughly summarized by the statement that weapon destructiveness has been increased a million-fold and with the development of missiles the speed of delivery has been increased at least a hundred-fold. The problems which confront civil defense have undergone a parallel revolution in which the area to be defended has expanded to whole nations and the time in which such defense must be activated has been reduced to minutes. Moreover, with these greatly increased demands has come a greatly increased responsibility because the possibility of survival and recovery may depend on the adequacy of civil defense.

The details of the role which civil defense can play in attenuating the effects of large scale nuclear attack clearly deserve the most serious consideration. Obviously, however, its role is limited on the one hand by the scale, effectiveness and overall cost of the civil defense program itself and on the other by the magnitude, targeting, and timing of the enemy attack. It is well to recognize at the outset the difficulty which these points impose on the evaluation of any civil defense program. The vast increase in the explosive power of nuclear weapons makes destruction very cheap compared with the cost of what is destroyed. Military projections give every reason to expect that the destruction capability of both sides will continue to increase. Moreover, other powers may develop nuclear forces. In the absence of substantive disarmament, the existence of the nuclear threat is likely to continue indefinitely, to grow in size and in variety of attack options and to diffuse outside the present east-west polarization.

Against a continuously expanding threat there is a certain logic in proposing the maximum civil defense. Theoretically, the greatest protection would be provided by building a stand-by production capability and civilian shelter system deep underground. Such a massive program would require the major share of the gross national product for about a decade and only somewhat less thereafter for maintenance. An effort of this magnitude would, of course, radically change the national character and seriously transform our way of life. Yet, if one were certain that a full nuclear attack would occur within the next decade or two, a decision to mobilize our resources for conversion to underground living would not be so unthinkable. Public attitudes toward this situation are not fully consistent and are difficult to assess. Public opinion polls are useful indicators of trends concerning opinions on the likelihood of nuclear conflict, but the

actual fraction responding in a given way as to their belief is very dependent on the formulation of the question asked. While various polls indicate that a substantial fraction of many Americans believe that nuclear attack is likely and that if it occurs, it will be within the next decade, it appears that this fraction has decreased during the last decade, though not substantially during the last few years. Furthermore, this belief is not coupled with any inclination to build underground. Although this assessment and reaction are largely intuitive they underline the hard choices facing civil defense in the nuclear age. The maximum civil defense effort would take away from us most of the things we cherish in our civilization. Yet to scale down the effort to the point where it is not socially intrusive or excessively expensive could render the effort useless.

Even if nuclear attack is considered possible only as a result of accident, miscalculation or unknown circumstances arising as new nuclear powers emerge and old ones undergo political change, the possibility of its occurrence diminishes greatly but remains finite nevertheless. This brings us to the heart of the problem. While conceding that maximum protection would cost us much of the wealth and character of the nation, it is necessary to ask, how much less should we settle for when the odds are low but the stakes remain high? To what extent are we justified in scaling the effort to the odds rather than the stakes? And in conjunction with these odds and stakes, to what extent can we justify a given civil defense program if a probable consequence is a serious deterioration in the character of our society?

These are profoundly difficult questions. There is an understandable tendency to turn from them and ask what protection can be derived from the kind of appropriations, private investment and public participation that seem likely to be forthcoming. Of course, what is available in this manner depends on how well the public is informed, on the leadership displayed, and on the estimate of Soviet intentions as well as the state of confidence that the public has in the effectiveness of civil defense plans. While this is hardly the best base on which to build a stable long-term civil defense program, it does define the minimal civil defense program that can be envisioned over the coming years.

Between these two extremes, i.e., an all-out effort spurred by the assumption that nuclear war is inevitable and an effort tied more to the public mood than to technical estimates, lies a large array of options in civil defense. Among these options is the new program of the Office of Civil Defense (OCD) and the plans being formulated by the Government agencies, now given specific responsibilities under the coordination of the

Office of Emergency Planning (OEP). Our terms of reference, which are listed explicitly in Annex "A", focussed primarily on the evaluation of these programs and plans and it was to this that we gave primary attention. Nevertheless, in acquainting ourselves with the vastness of the problem and the severe limitations imposed upon it, we could not avoid developing a somewhat broader view of civil defense. A sketch of this is given in the next part so that this frame of reference can be referred to in later discussions.

B. The Nature of Civil Defense

The nature of civil defense is determined largely by the types of attack that can be expected. Since the attack capability of a potential enemy is itself the product of new technologies, particularly those of nuclear weaponry and delivery vehicles, combined into highly integrated systems, it has become increasingly apparent that civil defense in the thermonuclear age must be conceived in a similar framework. Thus, radiation protection is based on a broad scientific discipline and its implications require a highly sophisticated integration of engineering and constructing effort, that is, a new technology. Likewise, protection against blast and against fire must give rise to other technologies if one is to limit the threat from these effects. Moreover, the utilization of such protection is crucially dependent on adequate warning, on effective communications during and after an attack and upon a monitoring service that can provide continuous information on radiation levels in every locality. These highly specialized efforts also require new developments based on research, new production and a new kind of management of what is produced. Consideration of these interrelations within civil defense itself leads naturally to the broader problem of the interrelation of civil defense with other aspects of national security.

The overall view of the entire security problem is schematically indicated in the accompanying Figure 1. It should be observed that civil defense (or "protective" measures) forms a part of a closed loop -- or feedback -- system which begins and ends with the strategic postures of the opposing sides. It will also be observed that the attack could be by either side and could refer as well to a retaliatory as to a first strike. A third observation is that the feedback diagram can be interpreted as the delineation either of an actual attack, in which case the important outcome is the probability of national recuperation after attack, or of a potential attacker's estimate of his opponent's recuperative powers, in which case the important outcome is the effect of the attacker's estimate on his strategies and strategic military posture.

In any event, the adopted strategic postures and strategies determine the kinds of attack that may result, for example, the division as between

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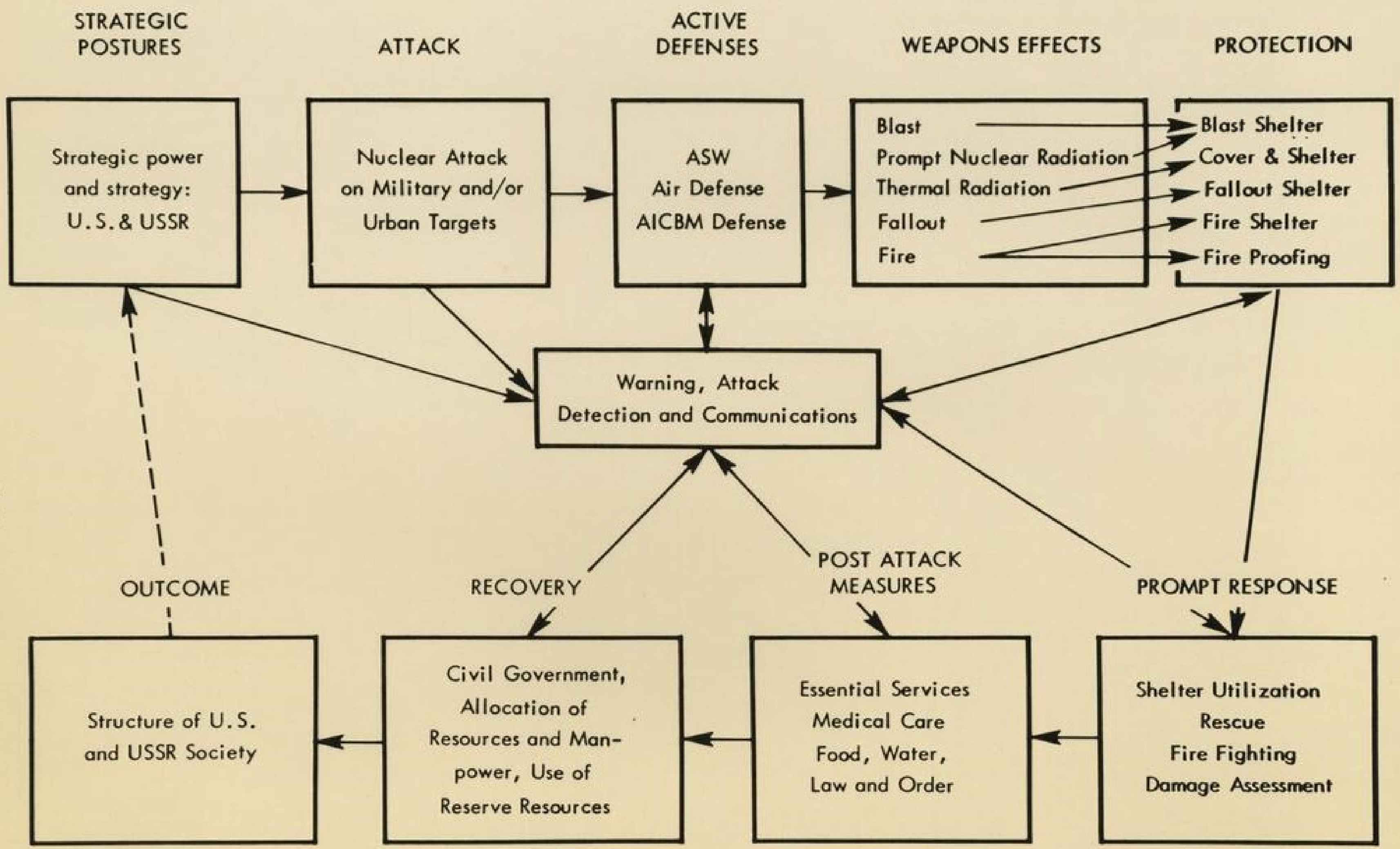

FIGURE I. AN OVERALL VIEW OF NUCLEAR WAR, WITH EMPHASIS ON THE ROLE OF CIVIL DEFENSE.

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military and urban targets. The attack, whatever its nature, must penetrate whatever active defenses the opponent has mustered, and the penetrating residue produces the various weapons effects noted in the Figure.

These effects produce various categories of damage: direct damage to life, property and resources, disruption of essential services, fragmentation of the economy and of the civil government. The function of the various components of civil defense is, first, to save lifes; second, to restrict the physical damage as much as possible; and finally, to retrieve as much as possible from the national potential that remains. The possible protective measures are of various characters and apply to different epochs after the attack.

The prompt non-military measures are applicable to the earliest epoch. They involve more or less prompt warning, sheltering of various sorts, and the important--and necessarily prompt--measures of fire control, rescue, and immediate medical attention. The time relevance of these measures extends from the earliest possible warning time, as in the case of blast sheltering, to several weeks in the case of fallout shelters.

The post-attack measures also begin with the attack, but extend somewhat farther down stream in time than the prompt measures. The immediate post-attack period is perhaps the most difficult and critical period of all, representing a race against time to save lives and property and to substitute some form of political and economic order for an incipient chaos. Clear assignments of responsibility and detailed planning on a very broad basis are required if this period is to be successfully spanned.

The final epoch is the long-haul period of recovery once the economic and political wheels have been set in minimal motion. This period is more or less stringent according as hostilities of some sort do or do not continue.

The essential point of Figure 1 is that civil defense, although itself a complex subject with many interactions, is only one aspect of a very broad and complicated picture of the origins and consequences of nuclear war. We shall attempt in this Report to assess and evaluate the technical components of civil defense. But by its very nature a civil defense program can interact extensively with civilian life, and as a consequence we have inevitably been led to some consideration of the social and political interactions.

C. Organization of the Report

The parts which make up this Report have a grouping that should be made clear. Part II is technical background, emphasizing the more important features of weapons effects and summarizing damage estimates for different attack patterns. It does not aim to be comprehensive and assumes some knowledge of nuclear weapons effects.

Part III outlines the present and projected civil defense programs. Then in Part IV, the functions and risks of civil defense are examined in a way that brings out the strategic questions involved; this part develops the points made in this introduction.

Parts V and VI represent an attempt to provide an evaluation and a critical examination of the fallout shelter program and of some of the most pressing aspects of the post-attack period. Against this background, the present deficiencies in technical knowledge are outlined in Part VII.

In Part VIII the problems of divisions of responsibilities between local, State and Federal Governments and the role of the Armed Forces is analyzed. The summary and conclusions are presented in Part IX.

II. TECHNICAL BACKGROUND

A. Introduction

The purpose of Part II of this report is to review the principal areas of technical information that are relevant to the nation's present civil defense program and its future plans. The following subjects will be discussed: Mechanisms of Civil Damage from Nuclear Explosions; Damage Caused by a Single Explosion; Protection Methods; Estimates of Soviet Nuclear Strength; Types of Attack; and Estimates of Attack Damage.

Since the discussion assumes some prior general knowledge of these matters, no attempt has been made to treat any of the topics exhaustively. Although the data presented here have been taken from many sources, the most frequent source has been the 1962 edition of the AEC handbook, "The Effects of Nuclear Weapons," to which the reader is referred for more complete information. Many of the illustrations that appear below have been taken from this source.

B. Mechanisms of Civil Damage from Nuclear Explosions

The civil damage resulting from the explosion of a nuclear weapon is produced principally by the three phenomena: blast; heat and light; and nuclear radiation. The relative importance of each of these damage mechanisms for a given attack would depend strongly upon such factors as yield and burst height of the weapon, exposed or sheltered population, weather conditions, etc. It is one of the purposes of Part II of this report to review what is and is not known about the relative importance and interaction of these factors.

1. Blast

The blast damage from a nuclear explosion is principally a consequence of the air shock wave that emanates from the point of burst at a speed greater than that of sound. As this shock wave passes a particular point there is a sharp rise in air pressure by an amount called the "overpressure." This persists for several seconds; then for an even longer period the air pressure is less than normal. The pressure wave is accompanied by a wind gust of lesser duration, which is followed by a wind reversal.

The chief causes of structural damage and casualties from blast are the following: ground shock; overpressure; wind; debris; entrapment in

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collapsing buildings; and innundation by sea waves.

a. Ground Shock

The direct ground shock that propogates outward from the crater of a surface burst is of importance only in determining the design of any special highly protective structures near the actual crater. Air-induced ground shock, from either a surface or an air burst, determines the criteria (primarily overpressure) to be used in the design of underground protective construction.

b. Overpressure

Values of overpressure greater than 5 psi cause very severe damage to conventionally designed closed buildings.

c. Wind

At 5 psi overpressure, the accompanying wind gust has greater than hurricane velocity: 160 mph for a surface burst, and even higher for an air burst. This wind might knock down solid tower-like structures that were undamaged by air overpressure, as well as the skeletons of structures whose skin had been shattered by the pressure wave.

d. Debris

The wind gust creates high-velocity missiles out of glass, rocks, bricks, splinters, etc., and these are a major source of casualties to exposed people.

e. Entrapment in Collapsing Buildings

This is a major cause of casualties.

f. Inundation by Sea Waves

This could be serious where deep water exists off shore. A 20 megaton underwater burst in water 500 feet deep can cause a wave having a trough to crest height of about 130 feet at a distance of two miles. For shallower water at the point of burst, the wave height would be correspondingly less; for deeper water the wave height would be greater. Focussing of these waves by the local topography can cause massive inundation.

2. Heat and Light

a. General Characteristics

Nuclear explosions generate temperatures of several tens of million degrees. Depending on specific bomb design, approximately one-third to one-half of the total energy released is in the form of radiant energy. This energy is released in two pulses, the second of which is longer in duration and is the only one of thermal significance. Pulse duration increases with yield, being approximately 0.3 seconds for a 1 KT burst and 30 seconds for a 10 MT burst.

The intensity of thermal energy decreases with distance since it spreads over larger areas; it is also attenuated by scattering and absorbtion, e.g., by clouds and dust. The amount of thermal energy actually received at various line-of-sight distances from the point of detonation is inversely proportional to the square of the distance, and is directly proportional to the transmittance (clearness) of the atmosphere. Because of the latter factor, the thermal energy received at a given location depends strongly on the meteorological conditions.

The principal kinds of civil damage caused by thermal energy are flash blindness, retinal and skin burns, and fires which may spread into large conflagrations, or under some circumstances coalesce into firestorms. These are described below.

b. Flash Blindness and Burns

Flash blindness normally results only from direct viewing of the burst but can occur even without such direct viewing. Although the effects are temporary, they may persist for as long as several days and could thus have important consequences for post-attack behavior. The area over which flash blindness would occur depends on yield, height of burst, and eye adaptation. It is thus most serious for large yields detonated at high altitudes at night. Retinal burns are a source of some casualties, particularly at night; they are a hazard to persons looking directly at the bomb from even large distances.

Flash burns were a major cause of casualties in Nagasaki and Hiroshima. To facilitate calculation of flash-burn effects, it is noted that the thermal energy requirement for first-degree burns increases from about 2 cal/cm^2 for a 1 KT weapon to 4 cal/cm^2 for a 20 MT weapon; the requirement for third-degree burns increases from 6 cal/cm^2 to about 11 cal/cm^2.

c. Widespread Conflagrations

Since a high-yield nuclear burst will start many fires simultaneously, widespread conflagrations should be regarded as a very serious danger. It is difficult to judge both the probability of their occurrence and the area over which they would spread. However, both occurrence and extent clearly depend upon: (1) the number of ignition points in an exposed area (which in turn depends on the distribution of combustibles and the level of thermal energy); (2) the density of combustible material in areas of primary ignition; (3) the existence of fire gaps; (4) local meteorological conditions; and (5) the effects of the blast wave that follows the thermal pulse. Blast effects would cause many secondary fires in a built-up area. Although blast would also extinguish some fires in regions of high blast damage, the effect of this would be relatively insignificant and might well be offset by increases in the intensity of combustion.

The U. S. Strategic Bombing Survey reports that during World War II about 80 percent of the total bombing damage in Germany was caused by fire, even though approximately equal weights of incendiary and high-explosive bombs were dropped. The fire-causing potential of nuclear weapons is perhaps less well understood than that of incendiary bombs, but the earlier data do emphasize the great damage potential of fire.

d. Fire Storms

A fire storm is a possible, but not inevitable, consequence of a nuclear explosion above a city. This is illustrated by the examples of Hiroshima and Nagasaki. In Hiroshima, about 20 minutes after the detonation of the nuclear weapon, fires in the initial ignition area began to coalesce, and a wind developed which blew from all directions toward the burning area of the city. This wind reached a maximum velocity of 30 to 40 miles per hour two to three hours after the explosion. Because of the strong inward draft at ground level, the spread of fire was limited to the initial ignition area. Virtually everything combustible within this region was destroyed. In contrast, no such fire developed at Nagasaki.

The likelihood of a fire storm is strongly dependent on the local conditions which exist at the time of the fire. Figure 2 shows U. S. Strategic Bombing Survey maps, to a common scale, of the destruction produced in the five German cities that experienced fire storms in World War II. (German city construction parallels that in many U. S. urban areas and is probably more typical of that in the U. S. than is Japanese construction.) The storms appeared in cities varying in size from Hamburg (1.76 million) to Darmstadt (0.11 million).

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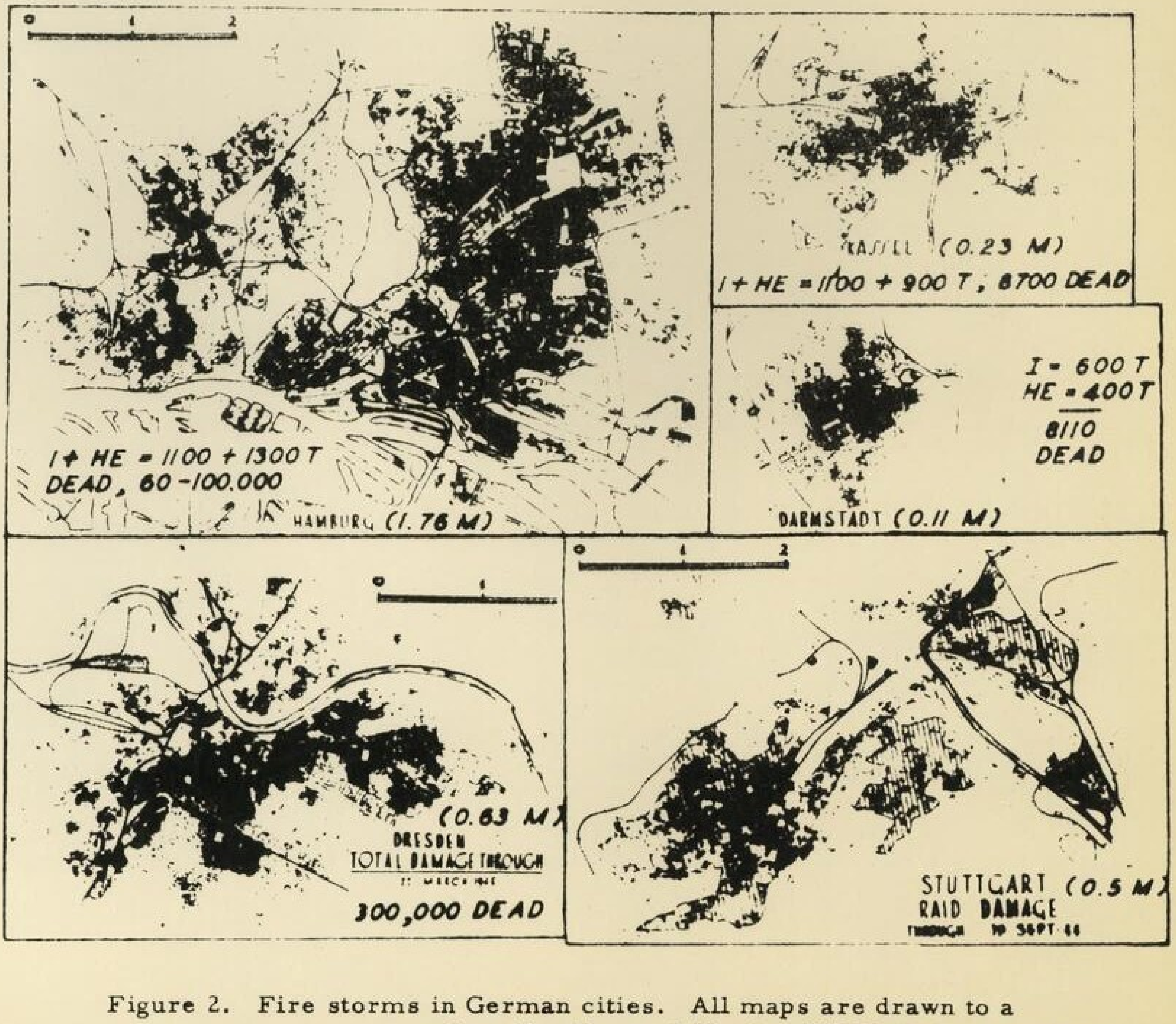

Figure 2. Fire storms in German cities. All maps are drawn to a common scale. The figures following "I/HE=" give tonnages of incendiary and high explosive bombs, respectively. The numbers in parenthesis are city population in millions. The black areas represent complete destruction by fire.

3. Nuclear Radiation

A great deal of information has been gathered about the radiation effects produced by nuclear explosions, and for this reason we shall describe radiation damage mechanisms in somewhat greater detail than was done for blast and thermal effects. This more extended description should not be taken as a measure of the greater importance of nuclear radiation in comparison to blast and thermal effects. Because of the extensive attention that radiation has received in comparison with other damage mechanisms, we have attempted in this Report to promote a more balanced view of the relative importance of these effects. None of the damage mechanisms is intrinsically more significant than the others. Each requires careful study, as do their combined effects, if the probable consequences of nuclear attack are to be realistically appraised.

a. Initial Nuclear Radiation*

Initial nuclear radiation damage is produced by gamma rays, neutrons, beta particles, and alpha particles. Because of their short range the latter two can be ignored for civil defense purposes. Neutrons and prompt gamma rays can cause casualties and death over considerable distances; however, the area in which they produce casualties is generally smaller than the area where blast is extremely destructive. Hence, these radiations would not be of great concern in estimating casualties for an unsheltered population or for a population housed in shelters that were designed only for fallout protection.**

If shelters were constructed with a high level of protection against blast and thermal damage, so that they would be effective even at short distances from ground zero, then initial nuclear radiation could become a

* Defined here as radiation produced during the first minute following a detonation.

**For typical air bursts the ranges at which an unprotected man would receive 100 rem from 1MT and 10 MT weapons are 1.8 miles and 2.9 miles, respectively. Peak overpressures at these ranges are 12.4 psi and 18.8 psi. These overpressures would destroy all typical houses and severely damage reinforced concrete or steel-framed buildings, but the radiation would cause only mild sickness in a small part of the population. Note that we are ignoring here the remote possibility of pure radiation weapons of large size.

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significant problem. At one mile from a 1 MT surface burst, for example, 24 inches of concrete would provide only marginal radiation protection (i.e., a large proportion of the occupants so sheltered would die from the initial radiation). Thirty-six inches of concrete would reduce the dosage to less than 100 rem and eliminate fatalities. These thicknesses, with proper steel reinforcing and suitable spans, would readily sustain the expected blast overpressure of 36 psi.

Knowledge of initial radiation effects on personnel is adequate. Since neutrons and gamma rays have different penetration characteristics, they require somewhat different protective measures.

b. Early Fallout

The primary hazard from nuclear radiation results from the creation of radioactive particles in the weapon residue and from the radioactivity that is induced in the earth, sea water, and other materials in the vicinity of the explosion. We shall consider radioactive fallout in two parts, early and delayed, with the early fallout being defined as that which reaches the ground within 24 hours after the burst.

For a given weapon size the amount of radioactive fallout which is produced depends on the burst height of the weapon, and on the relative quantity of fissionable material in the weapon. It is the surface burst or very low air burst, where the fire ball touches the ground, that produces intense radioactive fallout over large areas. For a high air burst, the fission products are dispersed into and beyond the upper atmosphere and lead to delayed, low intensity fallout.

At any given distance from a surface burst some time will elapse before the arrival of fallout. The larger, heavier particles return to earth faster and at a shorter distance from the ground zero. Initially the intensity at any point will increase with time; but since the induced radioactivity of the particles decays rapidly with time, the total intensity at any point will reach a maximum and then fall off. The times at which these changes occur are dependent on the distances from the point of burst and the magnitude of the winds.

To illustrate the general character of early fallout, we first consider the case of a 5 MT surface burst with 50 percent fission yield. Figures 3 and 4 show the radiation intensities and accumulated doses that would be observed for these conditions at two different downwind locations during the first hours after the explosion. The sequence of events indicated in the figures can be summarized briefly as follows.

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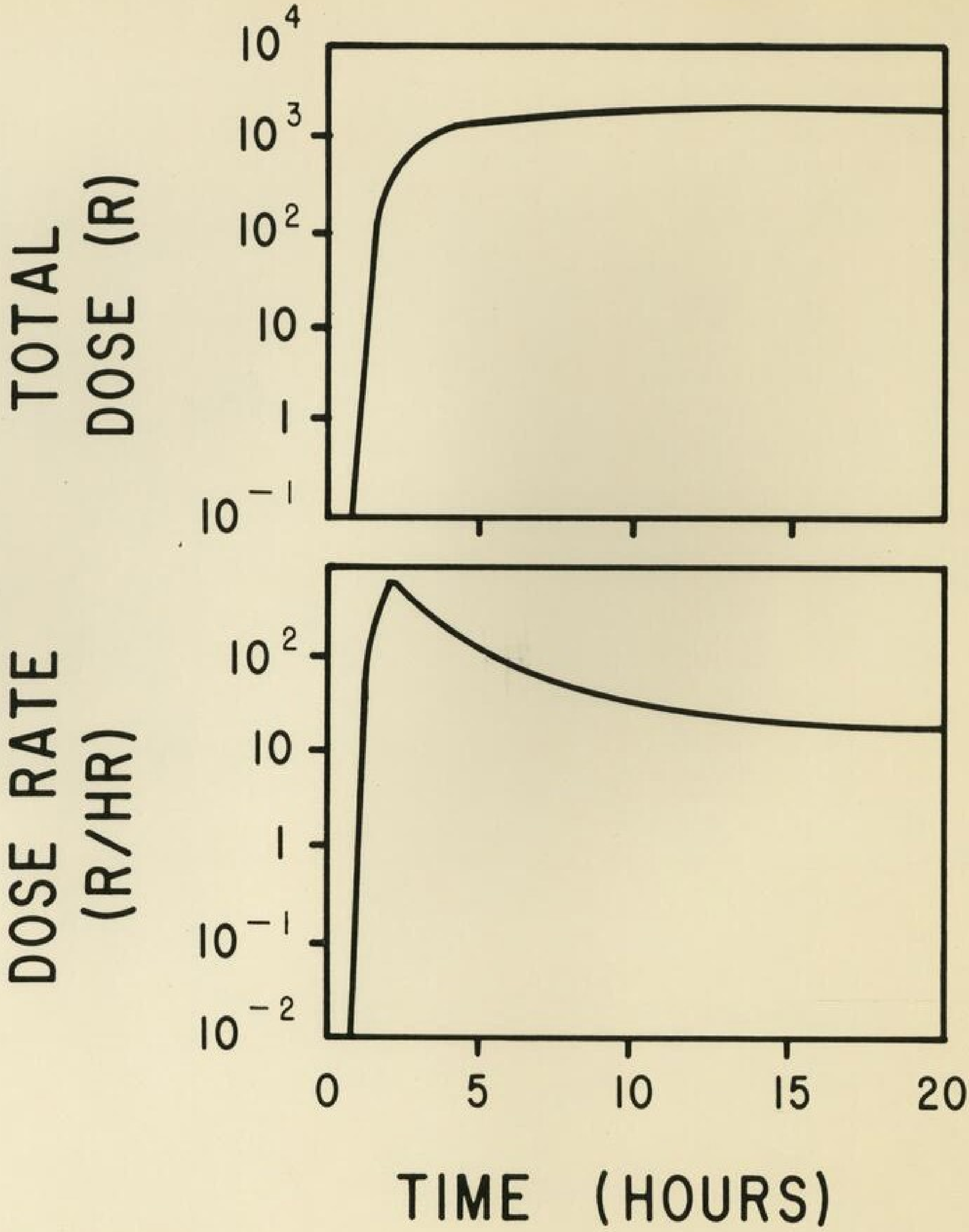

Figure 3. Dose rate and accumulated dose from fallout as functions of time after the explosion at 35 miles downwind. (5 MT surface burst with 50% fission yield)

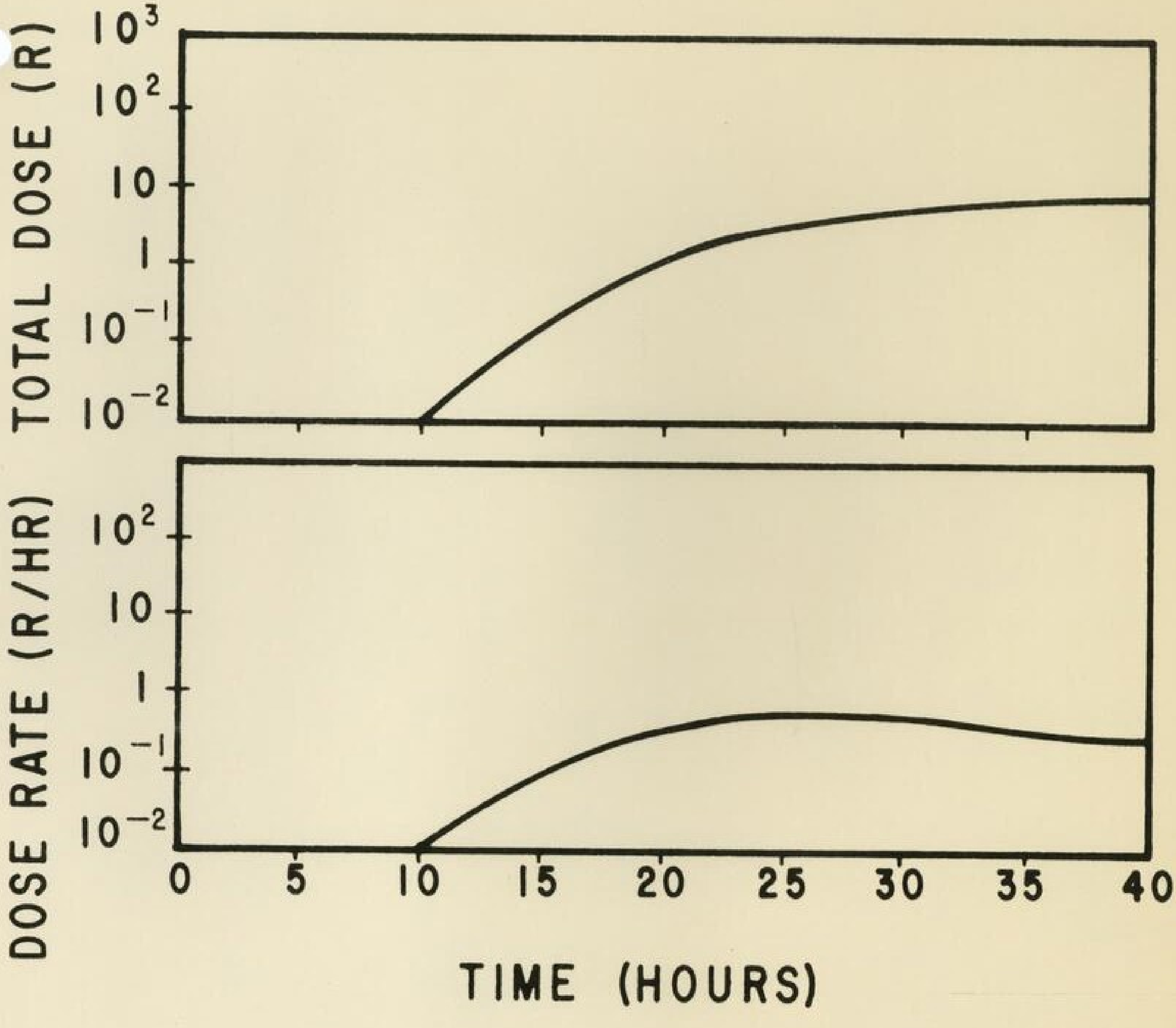

Figure 4. Dose rate and accumulated dose from fallout as functions of time after the explosion at 150 miles downwind. (5 MT surface burst with 50% fission yield)

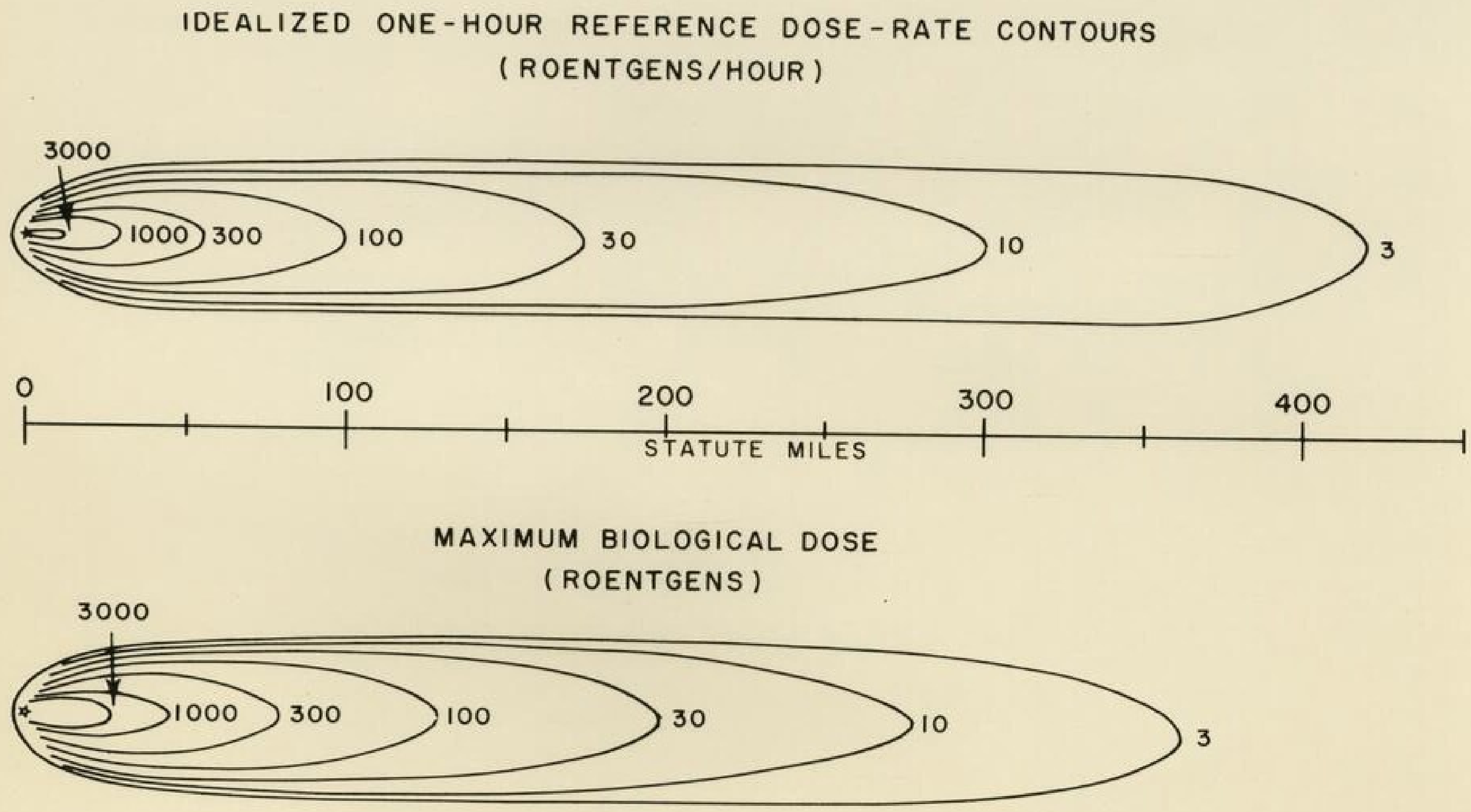

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Figure 5. Comparison of idealized one-hour reference dose-rate contours and estimate of maximum biological dose contours for a 1 megaton surface burst (50% fission yield). Effective wind speed is assumed to be 20 miles per hour. Reference dose rates assume completion of fallout deposition at one hour after burst. Maximum biological dose data are based on the actual arrival times of the fallout and the assumption that 90% of all radiation damage to body tissue is repaired, with 50% of the repair being completed in 30 days.

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At moderately short ranges (Figure 3), there is a short delay before the fallout arrives, then a rapid increase in radiation intensity until a maximum is reached in one or two hours. Thus a large fraction of the total dose is accumulated during the first few hours after the burst.

At longer ranges (Figure 4), there is a longer delay before the fallout arrives, then a relatively gradual increase in radiation intensity until a maximum is reached in 20 to 30 hours. Thus the total dose is accumulated more gradually.

In estimating the effects of fallout it has been common practice to make use of a theoretical "H ≠ 1 hour" dose rate, which is defined as the rate that would exist at a given point if <u>all</u> of the radioactive particles due to arrive at that point had actually arrived within one hour after the burst. An example of a fallout pattern computed with this theoretical dose rate is shown in the upper part of Figure 5. It should be emphasized that this fallout pattern (and H ≠ 1 hour dose-rate calculations in general) is <u>not</u> an accurate guide to the radiation dose that an exposed person would actually receive. A more realistic pattern is shown in the lower part of Figure 5, where the maximum biological dose has been computed as discussed in a later section (II.B.3.e) of this Report.

We have chosen to include an example of an H ≠ 1 hour dose-rate calculation here for two reasons: first, because this method is widely used to assess fallout effects; and second, because dose-rate predictions based on this method can have large errors. Although detailed criticism of the H ≠ 1 hour calculations is beyond the scope of this Report, we note briefly here the two principal factors that are not taken into account in these calculations.

(1) Delay in particle deposition. At a distance of 140 miles, for example, with a wind of 20 mph, no fallout would be received for about 7 hours.

(2) Decay of the particles. Fallout radiation intensity decreases by a factor of approximately 10 for each sevenfold increase in elapsed time. (This is often called the $t^{-1.2}$ scaling law; it is applicable for a period of about six months after an explosion, however, the intensity declines more rapidly thereafter.)

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It will be apparent that the corrections required to the H ≠ 1 hour calculations as a result of these two factors can be quite large.*

c. Contamination Effects

Contamination effects arise from two sources, radioactive particles that come in contact with the skin, and internal radiation from the inhalation of radioactive particles or the ingestion of food or water that is contaminated by fallout. Fallout particles in contact with the skin, in addition to increasing the total radiation absorbed by the body, can cause radiation burns and loss of hair. The hazard can be greatly reduced by the use of protective covering and by prompt removal of fallout particles through bathing. This hazard is not serious in comparison to other effects.

Internal radiation results when fallout particles are taken into the body orally or through wounds or abrasions. When contrasted with the potential dosage received from external radiation, the effects of internally deposited fission products should not be considered a serious problem in a post-attack casualty analysis. Some long-term effects may be observed, however.

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* The effect of these corrections can be illustrated by considering an area 140 miles downwind and an effective wind velocity of 20 miles per hour. Since fallout particles would tend to drift with the same velocity as the wind, deposition would not begin until about 7 hours after burst. By this time the total intensity from all particles due to arrive would be about 1/10 of that at h ≠ 1 (according to the $t^{-1/2}$ law). The deposition would continue for about 10 hours. Only at the end of the deposition period (H ≠ 17) would the intensity on the ground be predictable merely from the data in the upper part of Figure 5 and even then one must take into account the decrease in intensity due to the passage of time. Thus for this particular area the dose rate at H ≠ 17 hours is about 3r/hour, computed from the H ≠ 1 value of 50 using the $t^{-1.2}$ law. At all earlier times the radiation at this area would be less than that computed in a similar manner because the fallout deposition was incomplete. The difference is very substantial and, of course, increases with distance from ground zero.

In this connection it is useful to note that this difference between actual dose rate on the ground and that that would exist if all the fallout had been deposited at H ≠ 1 hours is scarcely affected by the fact that the fallout particles may be in the atmosphere above the ground. The attenuation factors for gamma radiation (0.7 mev) at distances of 300, 500, 1000, and 3000 feet in air are 5, 10, 30 and 300 respectively. Thus only that part of the fallout cloud quite close to the ground contributes to radiation there. A later consequence of this situation is that aerial radiation monitoring can be carried out at relatively low levels with comparative safety.

d. Delayed Fallout (Deposited after 24 hours)

The delayed fallout hazard is caused by very small radioactive particles that are dispersed in the atmosphere and return to earth continuously over relatively long periods of time. The quantity and distribution of delayed fallout are strongly dependent on weapon yield and on height of burst. As weapon yield increases, a larger fraction of the fission products is dispersed in the higher regions of the atmosphere where there is a longer residence time.

The hazard from delayed fallout appears to be quite small in comparison with the other expected effects of a large-scale nuclear attack. For example, at an attack level where blast fatalities may be as high as 30-50 percent of the population, and where casualties from early fallout may approach 25 percent of an unsheltered population, no significant fatalities would be anticipated from delayed fallout. In the case of early fallout, a typical attack on the U. S. (the RISK I attack of 3000 megatons) was estimated to result in an average integrated whole-body dose (4-day dose) of 100 r. Very crude estimates of delayed fallout from similar attacks suggest one-year average doses of less than 0.5 r. Since most biological effects are much less pronounced if the dose is accumulated over long periods of time, and since the remaining effects are generally proportional to total dose, the effect of delayed fallout appears to be much less important than early fallout or blast and thermal effects for an unsheltered population.

e. Biological Consequences

The biological effects of nuclear radiation on living organisms depend not only on the total absorbed whole-body dose but also on the rate of absorption and the extent of body exposure.

Figure 6 shows the incidence of illness and death in humans as a function of instantaneous whole-body dose. In the range of 100 to 150 r some individuals may become nauseated and later vomit; they may also show some fatigue but would recover rapidly in a few days. (It would be impossible to differentiate these individuals from others who show symptoms that are similar but of different origin except by detailed laboratory methods.) As the total dose for the first few days is increased, more severe symptoms appear and death can occur. At 270 to 300 r approximately 20 percent would die within six weeks. As the total dose is increased to 750-1000 r, 100 percent fatalities must be anticipated, with the first deaths occurring in 9 to 10 days. These data are strictly applicable only to initial nuclear

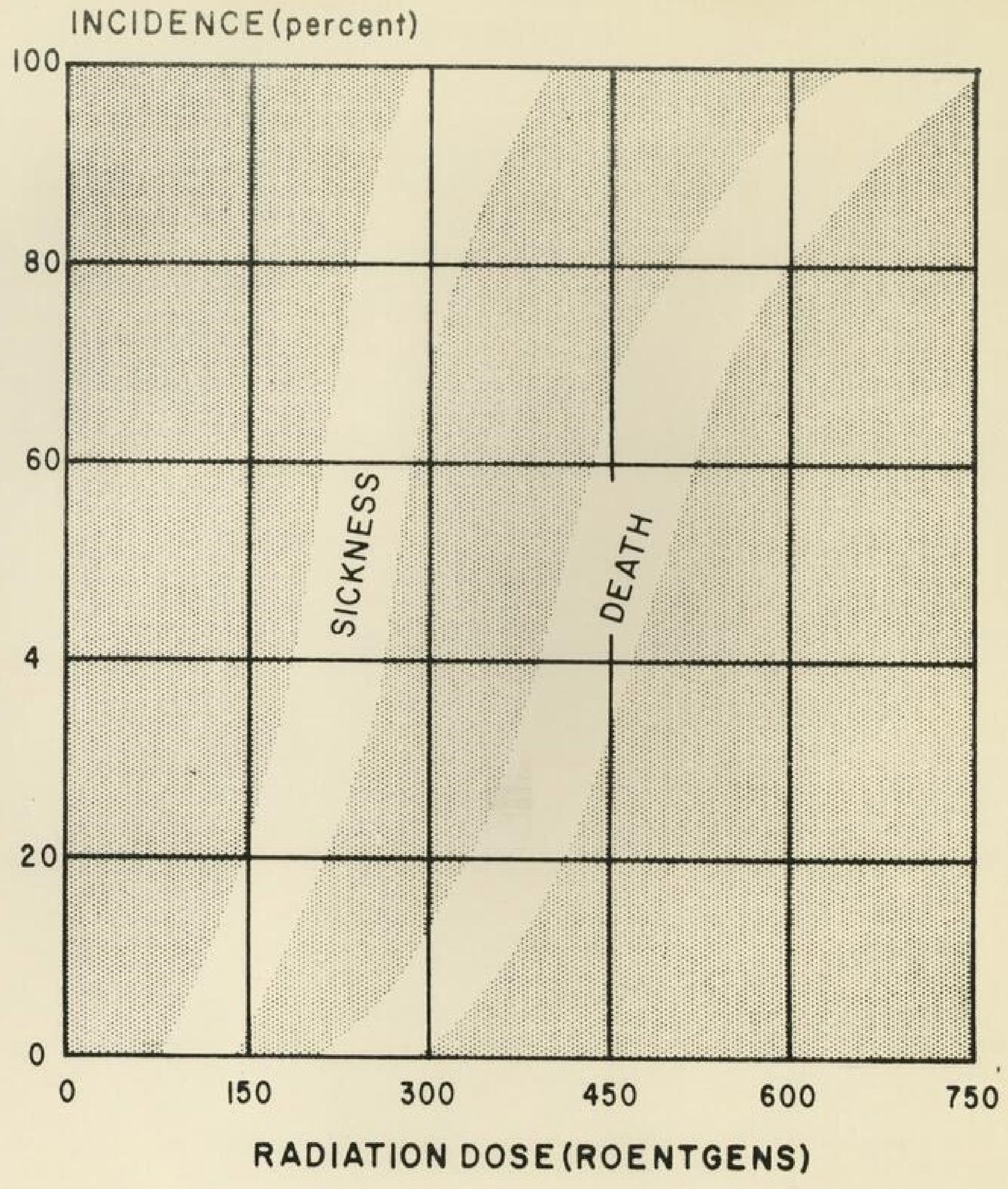

Figure 6. The incidence of death and illness as a function of instantaneous radiation dose.

radiation; the biological consequences for fallout radiation whose intensity decreases with time--the $t^{-1.2}$ law holds for the first six months--are not at all well known.

For fallout radiation it is clear that some fraction of the radiation absorbed produces irreparable damage to the body (the figure generally used is 10 per cent); given time, the body can repair the remaining fraction. The degree of repair may eventually be greater than 90 per cent. Thus the maximal biological dose that results from the absorption of fallout radiation over a protracted period of time is significantly smaller than the total accumulated dose. However, in contrast to somatic effects, genetic effects are not thought to be reparable, and therefore genetic damage will be more nearly a function of the total dose. It is important to note that the major contribution to the total dose is accumulated within the first four days.

If the usual assumptions about radiation repair are combined with the approximate decay law for fallout radiation intensity and with reasonable estimates of deposition rates, then in the dose range in which immediate illness or death occurs the maximum biological dose received by a continuously exposed person differs from the dose that would be absorbed in the first four days after an explosion by less than 20 per cent. As a consequence of this near equality, the four-day absorbed dose is taken as an estimate of the maximum biological dose. The relation of the maximum biological dose to the commonly used but less accurate H+1 dose rate is shown in Figure 7; this figure is also useful for estimating the maximum biological dose that a person emerging from a shelter would receive if he remained outside indefinitely.

Two important inferences can be drawn from the fallout data that have been given. (1) Shelter immediately after the descent of fallout is urgent; for example, in areas very close to ground zero, fully effective shelter for the first 12 hours would reduce the maximum biological dose by a factor of four or five; four days of such sheltering would reduce it by a factor greater than 10. (2) Even with a two-week period of shelter, however, some control over subsequent exposure may be necessary, either through decontamination or partial sheltering. In areas with reference dose rates of about 1000 r/hr the accumulated dose for persons who were completely exposed after spending two weeks in the shelter is of the order of 200 r, of which the in-shelter dose would be about 50 r (assuming a protection factor of 100). Thus early shelter occupants might still accumulate relatively high total doses on the basis of low dose rates (in this case about 1 r/hr) over a long period of time. The effects of such long, low-level exposures are not well known. For areas with

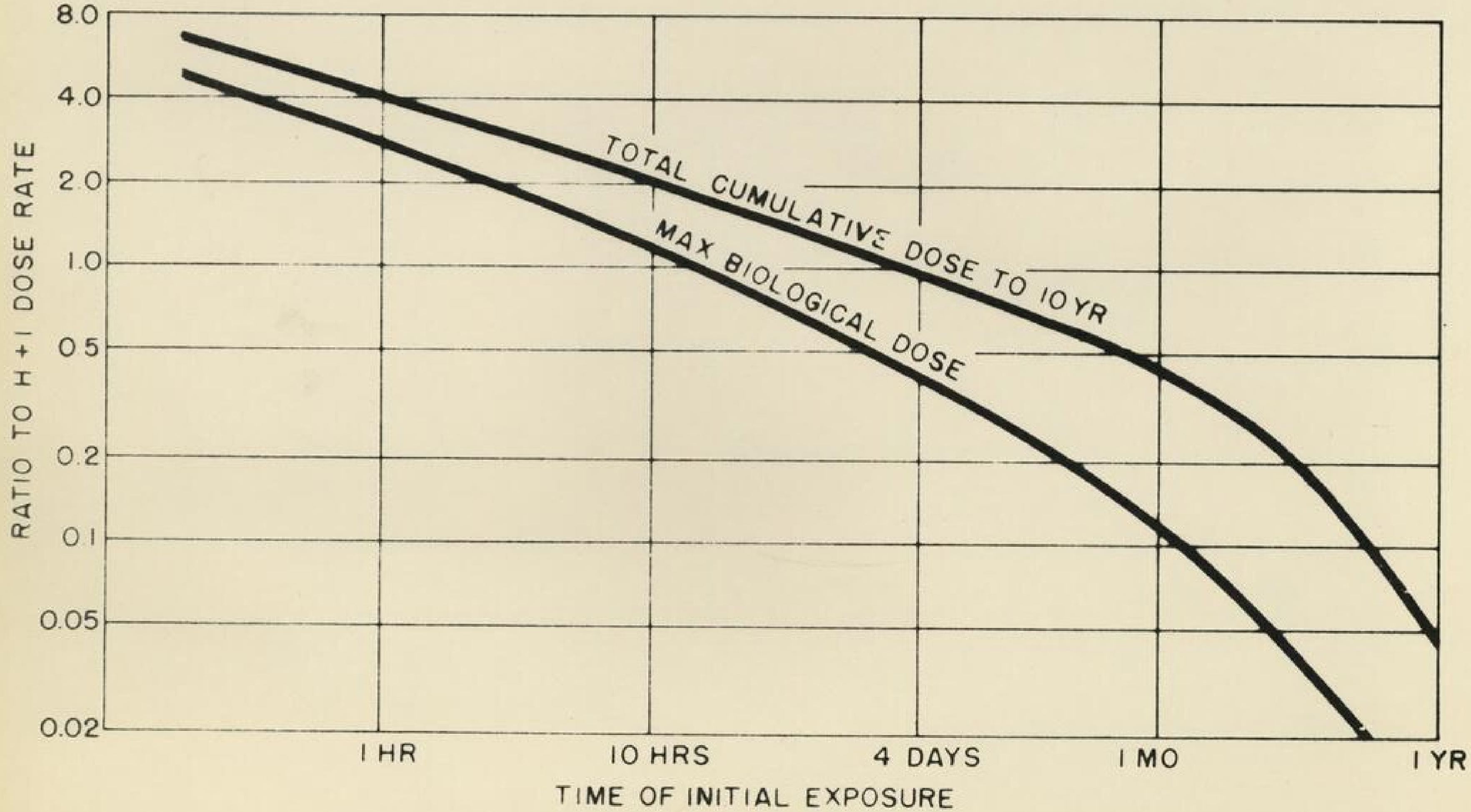

Figure 7. Ratio of maximum biological dose to H+1 dose rate. (The maximum biological dose falls below the total dose because a fraction of the radiation damage is repairable.)

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significantly higher dose rates, failure to control the post-shelter environment could certainly result in substantial fatalities.

C. Damage Caused by a Single Explosion

1. Twenty-Megaton Surface Burst

To illustrate the relative importance of the individual damage mechanisms described in Section II.B, an example of a single nuclear explosion will now be considered.* The example is that of a 20 MT surface burst of 50 percent fission yield. The approximate intensity of the blast, thermal and radiation effects from such an explosion is indicated in Table 1. These data are presented graphically in Figure 8, where the total area affected has been divided into six different regions to facilitate more detailed description of the varying civil defense problems that would exist in each region. Note that the maximum extent of blast damage is not shown in Figure 8; some windows would be broken at an overpressure of 0.1 psi, which in this example would occur at a distance of about 85 miles from ground zero. In addition, no attempt has been made to indicate the maximum extent of fire damage, since the spread of fire from regions of high heat intensity depends on meteorological conditions and such detailed factors as distribution of combustible material, etc.

The following is a description of the kinds of damage to be expected in each of the six approximate, idealized regions shown in Figure 8.

Region 1 - Region 1 is the area of most severe damage. In the inner part of this region, indicated by the inner circle, overpressure would exceed 32 psi, initial nuclear radiation would exceed 100 rem, and the total thermal exposure would exceed 1500 cal/cm^2. Even at the perimeter of Region 1, blast damage would be very severe. In the downwind direction, the fallout would be extremely intense (of the order of 10,000 r/hr in places), and within an hour the intensity over all of Region 1 would equal or exceed 150 r/hr. All exposed objects in Region 1 would be subjected to at least 170 cal/cm^2; all conventional fuels would be ignited; and all exposed personnel would be subjected to severe third-degree burns, to flying debris of high velocity, and to sudden lateral movements of at least 20 feet. Casualties for Region 1 would be very severe, and the prospects of assistance, which would be required almost immediately if survival were to be possible, appear poor.

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*Large variations in the indicated thermal and fallout effects could arise from changes in yield and other assumptions; these are discussed in the part that follows.

TABLE 1

COMPARATIVE EFFECTS DATA FOR A 20-MT SURFACE BURST (10 MT FISSION YIELD; VISIBILITY = 10 MILES; WIND VELOCITY 20 MPH)

	Range (Miles)	Area+ (Sq. Miles)
At least first-degree burns	31	3,000
At least second-degree burns	20	1,260
At least 1 psi	20	1,260
At least 5 psi	7.5	180
At least 30 rem (initial)	2.8	25
At least 100 rem (initial)	2.6	21
30 r/h area integrated to first-degree burn line	--	1,500*
100 r/hr area integrated to first-degree burn line	--	1,100*
At least 30 r/hr fallout (1-hr reference dose rate)	600	50,000**
At least 100 r/hr fallout (1-hr reference dose rate)	400	25,000**
At least 300 r/hr fallout (1-hr reference dose rate)	250	10,000**
At least 1000 r/hr fallout (1-hr reference dose rate)	160	3,200**
At least 3000 r/hr fallout (1-hr reference dose rate)	80	900**
At least 1 psi and less than 30 r/hr		300*
At least 1 psi and less than 100 r/hr		540*
At least second-degree burns and less than 30 r/hr		280*
At least second-degree burns and less than 100 r/hr		540*

* Fallout radiation area measured out to first-degree burn line.

** Total fallout area out to specified unit-time reference dose rate line.

\+ Note that the total area affected by various damage mechanisms is not in itself an accurate measure of the total damage done, since this depends on many factors such as population distribution within the area, etc.

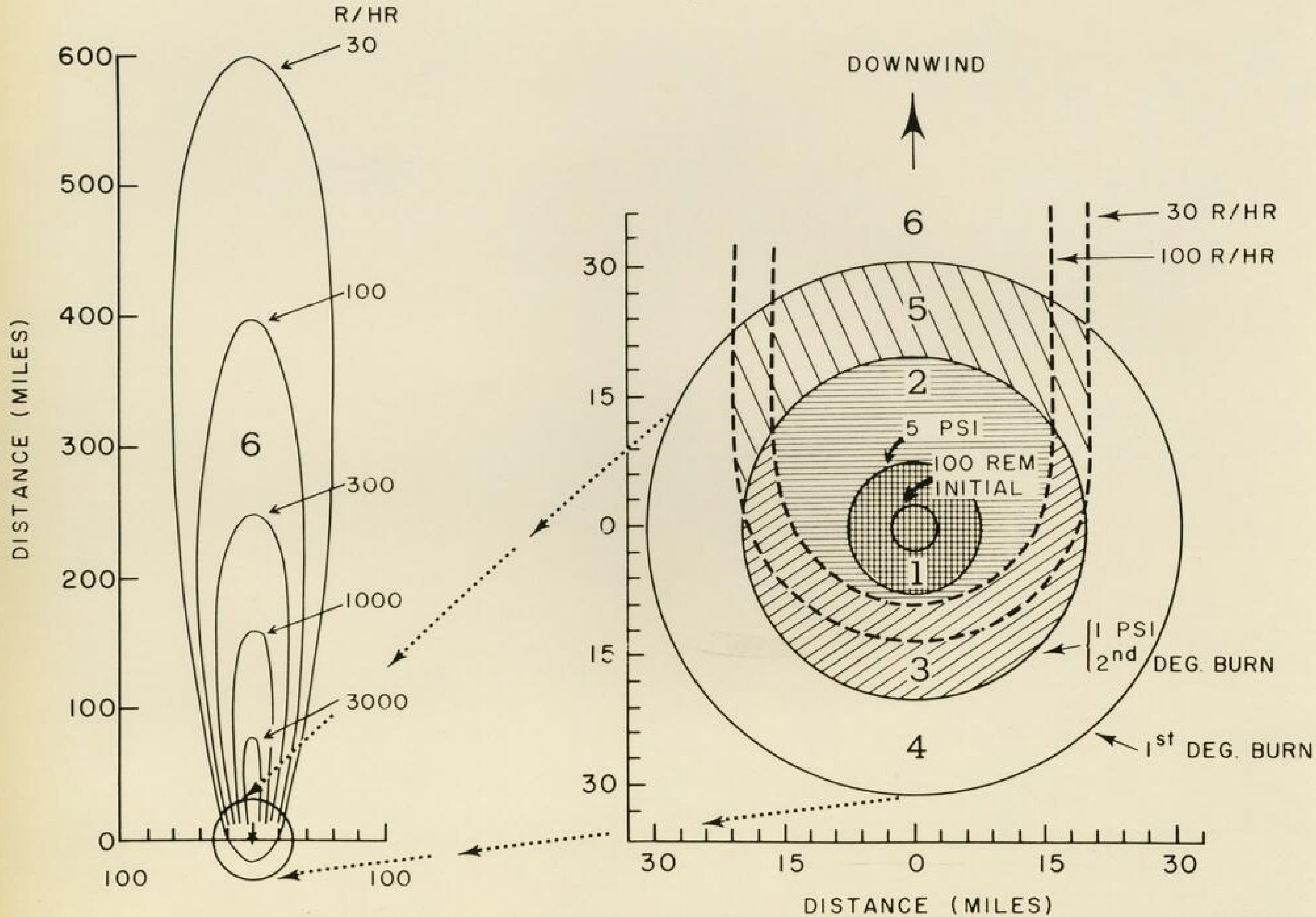

Figure 8. Weapons effects from 20-MT surface burst with 50% fission yield, including blast, thermal and initial radiation effects and H+1 hour reference fallout rates. Assumed effective wind velocity is 20 miles per hour. NOTE. The H+1 hour dose rates are theoretical reference values and do not give actual rates without further computation; see Figure 9.

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Regions 2 & 3 - These are regions in which all conventional structures would be damaged and all exposed surfaces subjected to at least 10 cal/cm^2. This is sufficient to ignite most conventional fuels. All exposed skin would sustain second- or third-degree burns. Winds of 160 mph would be experienced at the inner edge, and of 40 mph at the outer edge of the regions.

At the inner edge of Region 3 the H + 1 reference radiation intensity from fallout would be 100 r/hr; at the outer edge there would be no radiation of consequence. Region 2, most of which is in the fallout path, would be highly radioactive, and shelter from fallout would be essential for survival.

Casualties in Regions 2 and 3 would be heavy since, in addition to the fallout of Region 2, people would be caught in burning buildings, injured in building collapse or by flying debris, and would sustain either very severe third-degree burns if they were fully exposed, or burns of lesser degree if partially shielded. Fatalities would be high, but extrapolation from the Hiroshima data suggests that many persons in this area could be saved if rescue and medical care could be provided promptly.

Fires would pose a serious problem in these regions, both primary-ignition fires and secondary fires caused by blast damage and destruction. The extent of fire spread would depend upon such factors as the "built-upness" of the area, the number of primary ignition points, natural fire barriers, etc. Debris would greatly hamper the efforts of fire-fighting units within the area. Organized efforts to bring fires under control would probably have to depend upon outside assistance, and would be much more feasible in Region 3 than in Region 2.

The scope of the medical problem in these regions deserves special comment. The combined area of Regions 2 and 3 is about 1080 square miles, and in about 70 percent of this area rescue teams could work for several hours without receiving an excessive radiation dose. Since the total thermal exposure would range from 170 cal/cm^2 to 10 cal/cm^2, it is clear that a large fraction of the population in Regions 2 and 3 would sustain burns of sufficient seriousness to require immediate medical assistance. Adding the burn casualties to those produced by blast effects, the requirement for emergency medical care is seen to be very large. Since medical personnel and facilities within this area would also be badly damaged, the bulk of such assistance would have to come from other areas.

Regions 4 & 5 - Fire would be the principal cause of damage to structures and people in Region 4; blast damage would be largely confined

to window breakage. For most of the 1740 square miles of Region 4 fallout radiation would be negligible. Thermal exposure would range from about 10 cal/cm^2 to 3 cal/cm^2. Hence personnel would sustain burns ranging from second degree to mild first degree. Many structures would be ignited within these regions, but fire initiation would be a negligible problem at the outer fringes. However, even at the outer fringes structures would have been heated and somewhat dried and would thus be susceptible to fire spread. Medical problems would be severe, especially at the innermost points, with the care required consisting principally of treatment for burns, cuts, bruises, and wounds.

Region 5 poses blast problems that are similar to Region 4 but fallout would also be severe in Region 5. The severe fallout areas lie in about three-quarters of the 490 square miles contained within Region 5. Here only minimal measures to control fires could be taken by the personnel in the area, since the fallout would restrict the time that could be spent without protection.

The fallout-shelter problem in Region 5 is quite different from that in either Regions 2 or 6. In Region 2, existing structures could not be relied upon for shelter because of probable blast damage; the population, though very severely burned in many cases, would have to receive outside help or to seek improvised and probably inadequate shelter. In Region 5, the burn problem would be less severe but still quite serious, the fallout problems would remain, and fallout shelters would still be available if previously provided. However, the shelters might be in the path of wind-aided conflagration. A large proportion of those persons entering shelters in Region 5 would require extended treatment for burns; without such treatment, mortalities would certainly increase, and so would the in-shelter psychological problems.

Region 6 - Fallout is the only significant problem in Region 6. This region contains about 38,500 square miles when measurement is based on the H + 1 reference dose rates. Note, however, that the area in which a biological dose of 100 r would be accumulated is much less than half this size. Figure 9 shows maximum biological iso-dose contours (based on the assumption that 90 percent of the absorbed dose is repaired with a repair half-time of 30 days, and also taking into account radiation decay prior to particle deposition). This figure indicates that the region in which a dose of 100 r would be absorbed is about 10,000 square miles. The area in which at least 50 percent of fully exposed personnel would become fatalities (450 r) contains about 5700 square miles. Persons in this area, as well as in other parts of the Region 6, would have ample time to reach fallout shelters and could enter them in a relatively healthy

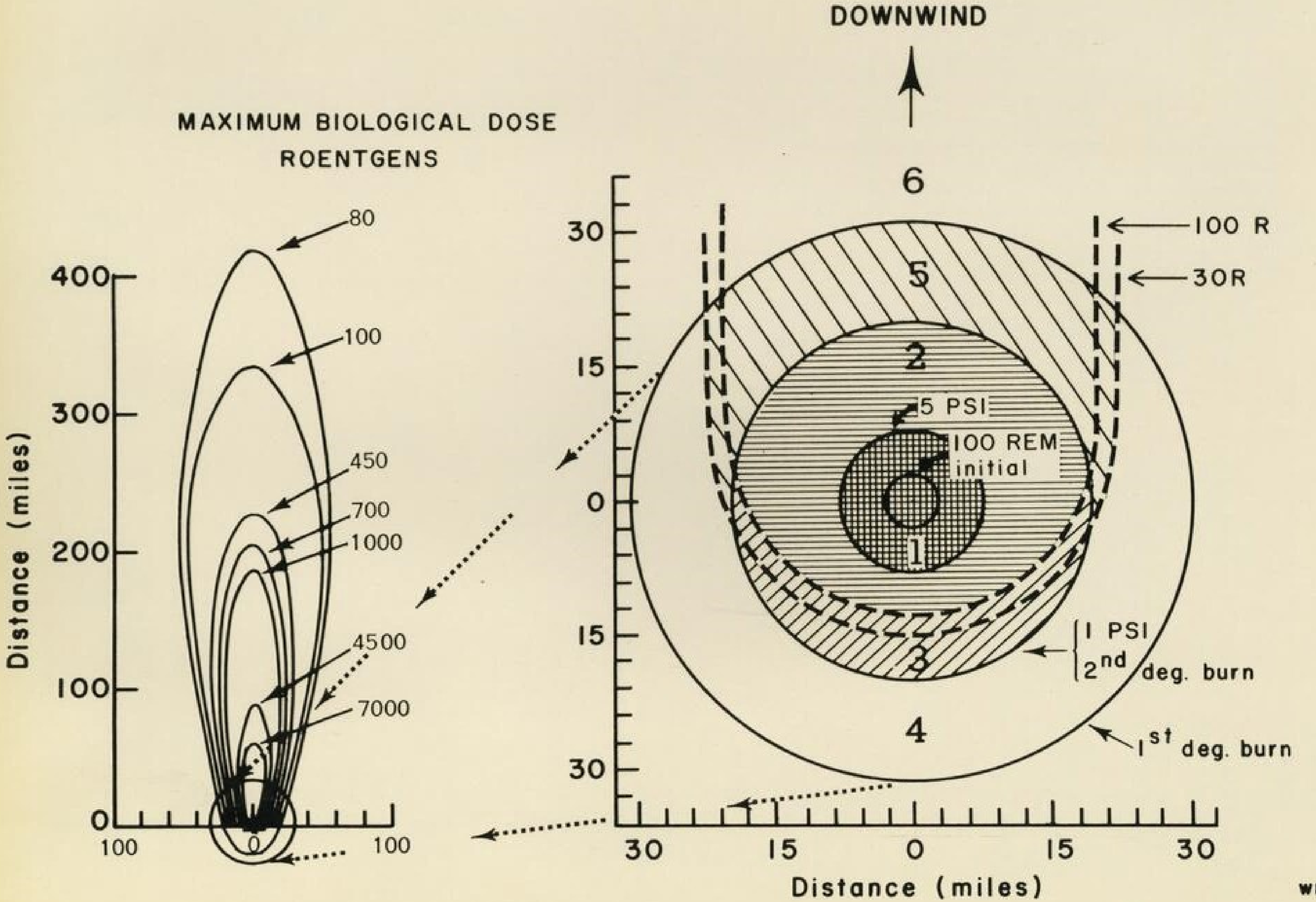

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Figure 9. Maximum biological radiation doses from fallout along with initial radiation, blast and thermal effects from same 20-MT burst as for Figure 8.

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and prepared state. This is the area to which the current OCD program is primarily addressed.

2. Dependence of Damage on Yield, on Burst Height, and on Weather

The example given in the previous section illustrated the damage to be expected for the assumed case of a 20 MT surface burst with specified visibility and wind velocity. The present section will describe, in quite general terms, the way in which the damage caused by a nuclear explosion depends upon the burst height and yield of the weapon, and also upon the prevalent meteorological conditions.

a. Effect of Burst Height

All of the damage effects of nuclear explosions vary with the height of burst of the weapon. For hard targets, maximum damage occurs for ground bursts. For soft targets, the damage from both blast and fire initially increases with increasing burst height, then reaches a maximum, then diminishes to a negligible value as the burst height becomes very large. For a 20 MT weapon, the maximum area subjected to blast overpressures of at least 5 psi would occur for a burst height of 26,000 feet. This area would be 450 square miles for the conditions stated, which is 2.5 times the area for a surface burst. The rate of increase of fire damage with burst height is considerably less. For example, as the burst height increases from 0 to 26,000 feet, the expected fire damage is increased by approximately one-fourth. For fallout, any increase in burst height decreases the expected damage, which of course becomes negligible when the burst height is larger than the radius of the fireball. For a 20 MT bomb the fireball radius is 2.3 miles; however, the effects from fallout virtually disappear for burst heights greater than 1.8 miles.

b. Effect of Weapon Yield

It is evident that the total blast, heat, and radiation hazards resulting from a nuclear explosion will all increase with increasing weapon yield. However, the relative importance of each of these three damage mechanisms may change for different weapon yields. Figure 10 indicates the general variation in blast, heat, and fallout intensities that would be expected for a range of weapon yields from 1 to 100 megatons and for the particular case of a surface burst.

For blast effects it is well known that the radius for a given overpressure increases with the one-third power of the yield.

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For heat effects, the best indication is that for megaton weapons very nearly this same one-third-power scaling law holds. The theoretical prediction in the case of heat is more complicated and depends upon the particular type of thermal effect being considered as well as on the clearness of the atmosphere. The value deduced for heat effects in Figure 10 was the 0.35 power of the yield, which we judge to be about correct for megaton weapons. Thus thermal effects eventually overtake blast in the total area affected from surface bursts, but not nearly as rapidly as has generally been thought before.*

The data of Figure 10 indicate that as weapon yield increases the area exposed to a fixed intensity of fallout radiation increases at a more rapid rate than either the blast or heat areas; however, a decrease in population density may completely negate the significance of a relatively greater increase in fallout area (e.g., if the target were a large urban area).

c. Effect of Meteorological Conditions

If one assumes a constant wind velocity of 10 miles per hour, then the area affected by early fallout from surface bursts depends on weapon yield to about the 1.1 power; this is a much larger increase with yield than is exhibited by either heat or blast. It should be emphasized, however, that the extent and specific distribution of fallout is strongly dependent on meteorological conditions at the time of burst, and further that the dependence on yield decreases as wind velocity increases. Since these same meteorological conditions also strongly influence the initiation and spread of fire, it is apparent that there must be a large degree of uncertainty in predicting the relative importance of these damage mechanisms. As an example of this uncertainty for the particular case of early fallout, data from the U. S. Weather Bureau indicate that dose rates and accumulated doses may easily vary with weather conditions by a factor of four.

D. Protection Methods

This section briefly summarizes some of the methods that can be used to gain protection against the various potential sources of damage resulting from a nuclear explosion.

1. Initial Effects

a. Initial Light Flash

Persons looking directly at a nuclear detonation may receive

*Atmospheric effects and failure of the reciprocity law on thermal damage appear to be the reasons for this.

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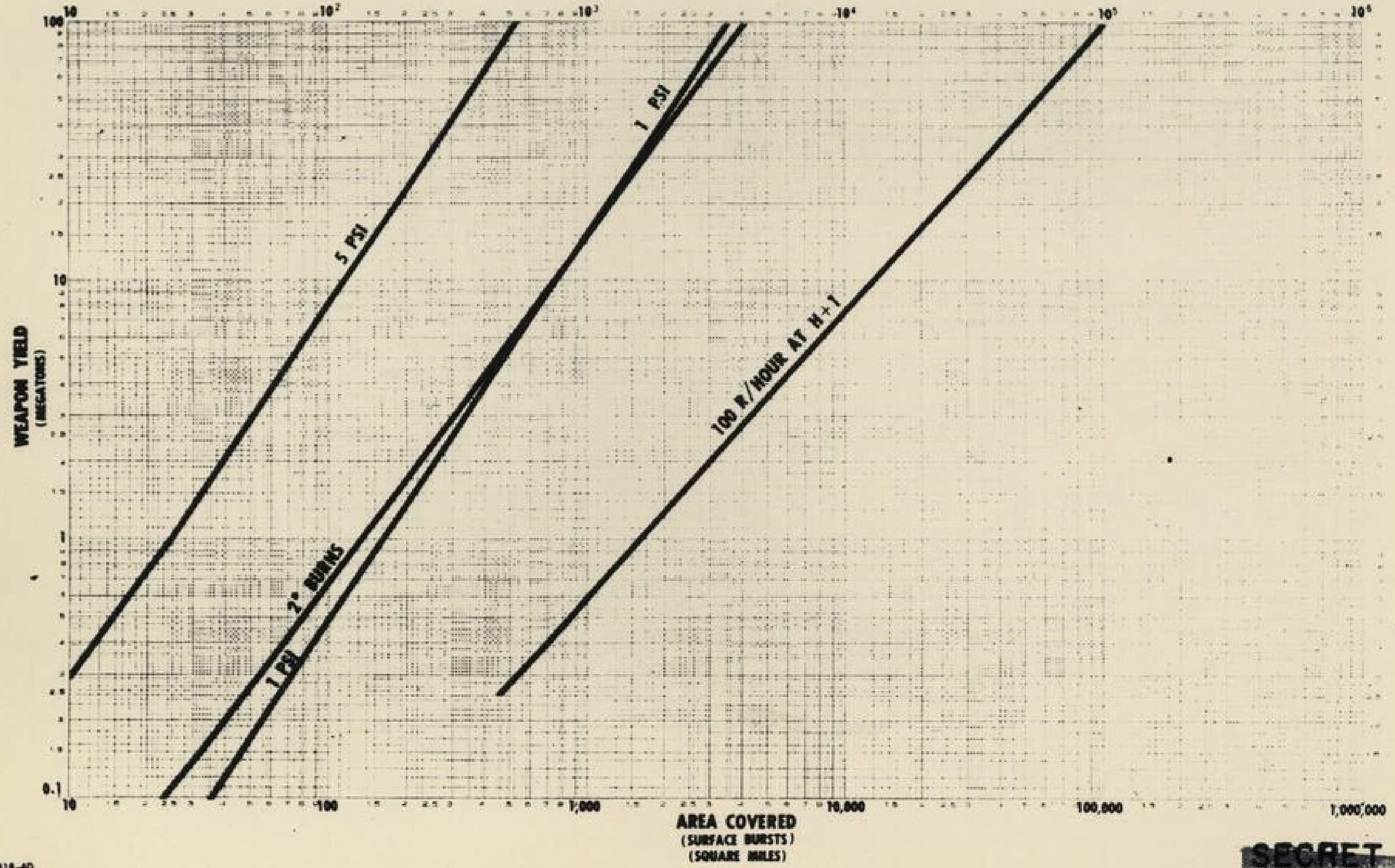

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Figure 10. Log-log plot of areas affected by blast, fire and fallout as a function of weapon yield.

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retinal burns and permanent eye injury even at great distances, this factor being variable with atmospheric visibility. Persons looking down or away would not receive such retinal burns; any opaque shield would provide complete eye protection.

b. Initial Heat Radiation

Burns to exposed skin become an increasingly serious problem as the weapon yield increases, especially for air bursts. As the yield goes up the duration of the heat pulse also increases, and it would therefore be possible for persons exposed at longer ranges to gain partial protection by promptly seeking cover, or at least by lying prone and using clothing as a protective shield.

c. Initial Nuclear Radiation

This would be a serious hazard only for occupants of blast-resistant shelters quite close to ground zero.

2. Blast

a. Overpressure

Of special importance is the substantial time which may be available for evasive action from blast effects. For example, at a distance of 10 miles from a 10 megaton burst, which is at the fringe of severe blast destruction (4 psi overpressure), the elapsed time between the initial flash and arrival of the air blast wave is 37 seconds. This may be sufficient time to seek partial protection, at least from secondary blast effects.

Complete protection would be provided by a fully sealed underground shelter designed to resist the expected overpressure and provided with blast-proof doors. Partial protection would be provided even if the shelter were partially open because the peak overpressure within the shelter would be less than that outside and the more gradual build-up of pressure would permit partial internal pressure equalization. Animals in shelters have survived exposure to overpressures as high as 90 psi.

b. Debris Carried by Wind Gust

Substantial protection against flying debris would be required in any region of 3 psi or more overpressure, which corresponds to a peak

wind velocity of 100 mph. Adequate shelter would be provided in the interior halls of any substantial steel-framed or reinforced-concrete building. It would be important to avoid areas near glass panels or loose objects.

3. Fire

Fires would be started by direct thermal radiation and by secondary blast effects that cause short-circuits, gas-and oil-line breaks, etc. Direct ignition may be minimized by reduction of inflammable papers and trash both outside and inside houses, and also by such methods as closing venetian blinds or painting windows white if enough warning time is available. Below-ground sealed shelters with several feet of earth cover would provide ample protection against direct fire effects and against heat build-up for fires of usual duration. In a shelter providing 100 cubic feet of air per person, for example, complete closure could be tolerated for nearly 4 hours. (See 1962 Hearings, p. 85 for more detailed information.)

4. Fallout

a. Protection against radioactive fallout would be of particular importance because of the large areas downwind from a burst that may receive a lethal dose. Protection would involve the use of enough shielding material to attenuate the radiation to a tolerable level. Sixteen inches of concrete or 24 inches of earth would provide an attenuation factor of 100. Since the initial dose rate from fallout radiation is relatively high, shelter occupancy during the first few hours after an explosion would be of special importance.

b. Direct contact with fallout particles may result in skin burns by beta-radiation. Removal of clothing plus prompt cleansing would minimize this danger.

5. Sea Waves

In low-lying coastal areas adjacent to deep and extensive bodies of water, basements would not be suitable as shelters. In such areas shelter should be sought only in substantially framed buildings that would be able to resist wave impact and inundation.

E. Estimates of Soviet Nuclear Strength

From the civil defense point of view the threat must be examined as a continuous function over the next several years. Its ultimate scope cannot be accurately predicted, for undoubtedly many decisions about the size of the

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USSR strategic force and its composition and capabilities have not yet been made. It is important, however, to consider trends in technical developments and also to attempt to indicate the range in which future attacks may lie.

It is assumed that sufficient intelligence data are available to readers of this Report so that it is unnecessary to describe the characteristics of potential Soviet attack systems in detail. The following discussion will thus be limited to a brief review of the principal data that have a direct bearing on civil defense problems.

1. Size of Individual Weapons

The table below lists the various classes of Soviet weapons systems and gives estimates of the present and future yields obtainable from the individual weapons in each class. The estimates of future weapon sizes have been extrapolated from the Bethe Panel's evaluation of the recent Soviet weapons tests, and they should thus be regarded as quite approximate. For all of the weapons listed in the table it can be assumed that roughly one-half of the total yield would result from fission reactions.

System	Current Total Yield (MT)	Future Total Yield (MT)
Submarine-Launched Ballistic Missile	2.5 - 3.0	5 - 7
ICBM, First Generation	6	25
ICBM, Second Generation	3	5
Air-to-Surface Missile	3 - 6	6 - 15
Aircraft Bomb	4 - 18	5 - 100

Present Soviet ICBM's can very probably carry the 25 MT weapon tested in the recent series, and BEAR bombers can probably deliver the recently tested 58 MT weapon (which could have a yield of 100 MT if a uranium case replaced the lead casing of the tested version). The use of these and other higher yield weapons could greatly increase the U. S. civil defense problem. In addition, the use of such large weapons could substantially modify the relative importance of the resulting blast, fire, and fallout effects.

2. Estimates of Total Deliverable Yield

The intensity of an assumed attack is usually specified by the total number of megatons delivered on the Continental U. S. This quantity in itself is not sufficient to permit detailed prediction of the kinds and degree of civil damage that would be caused, since the damage would depend strongly upon the tactical nature of the attack (counterforce or antipopulation, or a mixture of the two). Nevertheless, the total delivered yield will be used as the principal parameter for the later discussion of the damage to be expected from various kinds of attacks.

Because of uncertainties in such items as force-level estimates, tactical doctrine, warhead size, effectiveness of defense, etc., the estimates of total deliverable yield given below should be considered quite approximate. The estimates we shall use are taken from several studies that were made for the OCDM, the OCD, and other DOD agencies. The assumptions made in these studies (which are described more fully in Section II.G) were either approved by these agencies or provided by them.

The RISK I Study, sponsored by OCDM, estimated the net delivery capability of the USSR for 1962 at 3000 MT (1500 MT fission). The Army Study PAMUSA estimated total delivery capability for 1963 at 1930 MT. A 1961 WSEG Study, performed under the sponsorship of DDR&E (and aimed at evaluating the effectiveness of the currently proposed shelter program), estimated Soviet capability for 1961-1965 as lying in a range of 5000 to 10,000 MT fission delivered, or by implication a total delivered megatonnage of 10,000 to 20,000 MT. A more recent WSEG effort (WSEG Report No. 61) assumed that 8600 MT (total) could be programmed for delivery in 1963, and the model used suggested that about 5600 MT total could be delivered in a surprise first strike. The assumptions used in this last study were provided by the Joint Advisory Group of the Joint Chiefs of Staff and are currently being used as the basis for the RISK 2 Study which is sponsored jointly by OCD and OEP. All of these estimates are based upon current weapon-yield estimates and technology; they do not reflect possible increases in yield as a result of the recent Soviet test series.

An increase in net Soviet delivery capability could arise from either increased force levels or increased weapon yields. Taking only the latter case, it is estimated that the total deliverable yield could increase by a factor of at least two or three. Thus any civil defense planning should anticipate possible attacks in the latter half of this decade of approximately 10,000 to 20,000 total MT delivered. Although this estimate is necessarily based upon rather sketchy information, it would appear that Soviet technical capabilities would permit even higher

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attack levels to be achieved. We believe that any planning which does not take into account the possibility of attacks at these higher levels would be unreasonable and imprudent.

F. Types of Attack

To facilitate the later discussion of damage-assessment studies and their interpretation, we shall briefly describe here the three principal categories that are customarily used to characterize the tactical intent of an assumed enemy attack. It is clear that the pure counterforce and pure antipopulation attacks are opposite limiting cases. Military analysts usually assume that the most likely attack would be of the mixed counterforce-antipopulation class.

1. Counterforce Attacks

It is conceivable that an attack could take place in which the only targets were SAC home bases, TITAN and MINUTEMAN sites, and POLARIS home ports; this would be a pure-counterforce attack. However, it is likely that there would be great pressure upon Soviet military planners to include a broader range of targets, such as alternate SAC bases, SAC recovery bases, command and control centers, nuclear weapons storage sites, and key military and government communications centers. Many of these are in or near population centers.

2. Mixed Counterforce-Antipopulation Attacks

As the number and types of individual targets in the target complex is increased, an attack actually directed toward the reduction of U. S. retaliatory capabilities would become difficult to distinguish from a deliberate mixed counterforce-antipopulation attack. Even if population centers were to be included in the attack Soviet military planners might choose as specific targets air defense bases, SAGE and other air defense centers, military headquarters, Strac-tac bases, etc., in preference to actual city centers. This is because many of these targets are located within or very close to cities, and thus the damage done to population would not significantly decrease if the broader class of military targets were hit.

3. Antipopulation Attacks

A pure antipopulation attack would be intended to produce the maximum number of casualties for the yield delivered. A possible example would be a retaliatory attack in which the desire to punish the enemy is so

strong that self-interest (which might better be served by directing part of a second strike at the enemy's residual military forces) is almost entirely disregarded. Data on the probable results of such antipopulation attacks are important in estimating the potential damage that might be done by retaliatory attacks, or by the antipopulation part of a mixed attack.

G. Estimates of Attack Damage

The Panel has examined many of the damage assessment studies that have been made by WSEG, RAND, the National Damage Evaluation Center (NREC), and others. The RISK I studies of NREC are of particular importance because many of the Federal Agencies with emergency preparedness functions have assisted in their preparation, and also because these studies have become the analytical basis for many aspects of these Agencies' programs. The WSEG studies are significant because they have influenced the OCD program to a great extent. An Army Study, PAMUSA, is also important, not because of its impact on present programs, but because it represents the first major U. S. attempt to analyze in detail some of the operational problems that would occur in the immediate post-attack period. These three studies are described below.

1. The RISK I Computer Study (NREC)

a. Purpose

The RISK I Study was undertaken to estimate the hazard to the U. S. in 1962 from (presumably) feasible USSR mixed attacks. Particular emphasis was placed on evaluating the damage done to the U. S. population and to selected national resources.

b. Assumptions and Methodology

It was assumed that the USSR was capable of delivering about 3000 MT total (1500 MT fission) on U. S. targets. Each potential target was assigned a relative risk of being hit, and several sets of targets were selected through random choice. The resulting data were treated statistically to determine relative risks to specified overpressure and fallout levels, and also to estimate resource damage and casualty distributions. The attacks examined placed approximately 2000 MT on cities and industrial targets, and 1000 MT on military targets.

c. Results

The expected exposure to blast and fallout is summarized

in Figure 11. A large fraction of the population is exposed to very high H + 1 hour dose rates (55 percent to doses greater than 1000 r/hr) as a consequence of the heavy city orientation of the attack. The predicted high blast casualties are a reflection of the large fraction of the population (37 percent) exposed to overpressures greater than 3.5 psi.

The total casualties were estimated to be about 65 percent. Fatalities were estimated at about 53 percent. Survivors were estimated to have received an average residual dose of slightly over 100 r. Thirty percent of the labor force (20 percent in some critical categories) was estimated to survive. Twenty percent of the population was judged to be capable of engaging in emergency post-attack activities.

The study predicted that full use of fallout shelters by the U. S. population would reduce casualties from 120 million to 60 million. Use of shelters with 100 psi blast protection, in addition to fallout protection, was judged to reduce casualties to 10 million.

The predicted destruction of industrial capacity varied from 60 to 80 percent in most major durable end-product and machine-making industries (bottlenecks and systems interactions were ignored). The production of medical items was even more drastically reduced and transportation capacity severely cut, both in the face of expected large increases in demand.

d. Comments

The Panel has severe reservations about the validity of the assumptions made in the RISK I Study, of its damage assessment estimates, and of their implications. Since the conclusions of this study have tended to become the starting point for further plans of government agencies (including OCD), this is a matter of some concern. Specifically, the RISK I casualty and damage estimates do not take into account the effects of fire nor the effects of shortages and many other factors in the immediate post-attack environment. Since fire damage may be expected to increase greatly with anticipated increases in yield, estimates of the potential saving of lives through the use of blast shelters may be greatly in error. Moreover, the assumption of 100 percent shelter utilization is clearly unrealistic. In the assessment of damage done to various types of industrial plants and the degree to which production capacity would be reduced, many complex distribution and bottleneck problems that would have to be faced in the post-attack environment were ignored. As a result, the ability of society to continue to function in the post-attack environment and ultimately to recover to any specified level did not receive definitive evaluation in this study.

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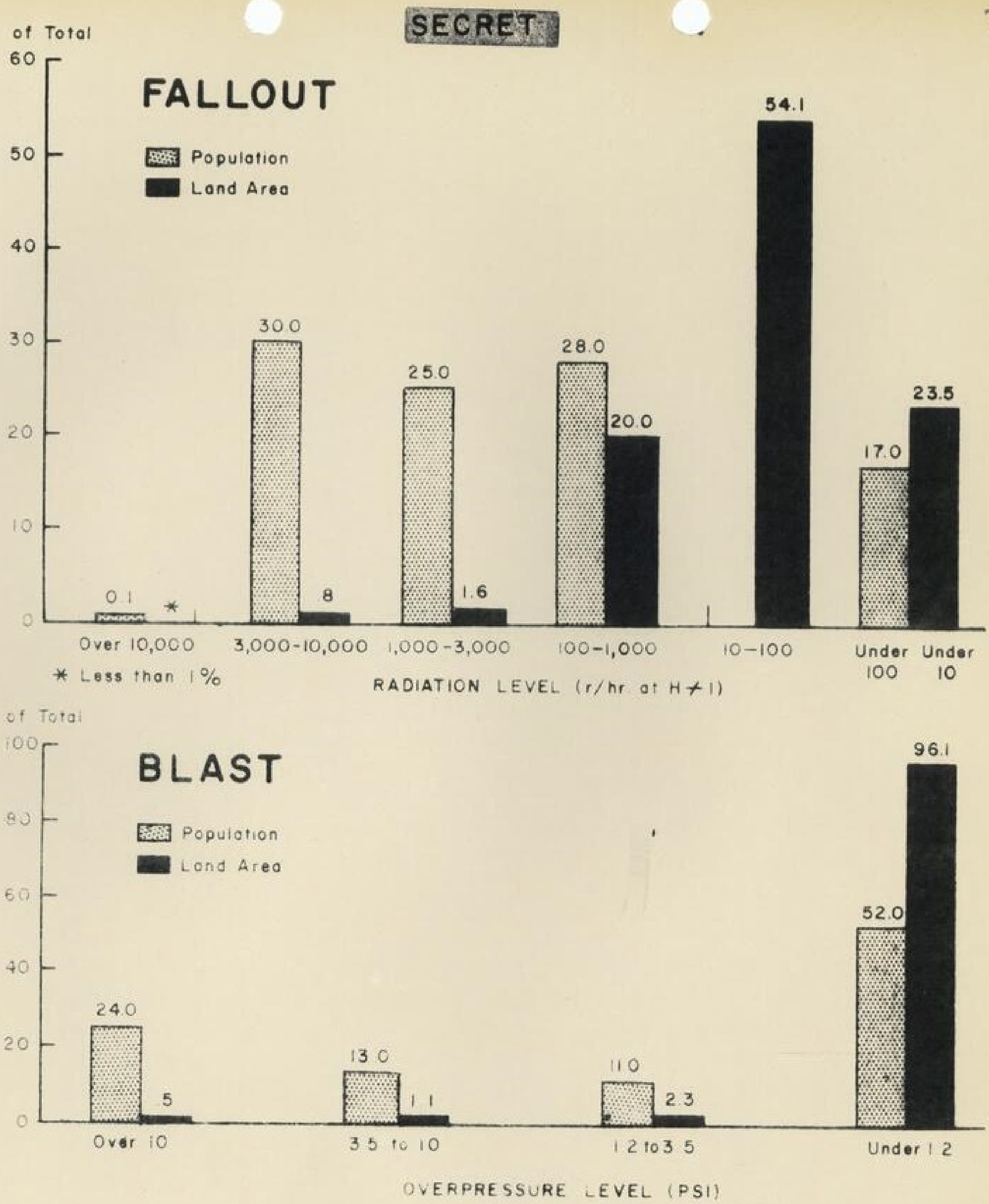

Figure 11. "Expected" exposure to fallout and blast, for both population and land area. Data are for the RISK I attack of 3000 MT.

2. The WSEG Studies

a. Purposes

Elements of three different studies by WSEG are relevant to the present Report and will be included here. These are a special study undertaken to evaluate the shelter program for DDR&E and OCD; a 1960 general strategic study, reported in WSEG Report No. 50; and an examination of the possible value of resiting military forces, reported in WSEG Report No. 61. Under the terms of reference supplied by OCD and other DOD agencies, WSEG has concentrated almost exclusively on the effects of shelter programs.

b. Assumptions and Methodology

The WSEG studies are based upon a two-part model, one part of which maximizes the fatalities resulting from weapons delivered to city targets, while the other part assumes "pure counterforce attacks" in which population fatalities are ignored and cities are not deliberately targeted. The results from the two parts are then combined in mixed attacks (with population fatalities added as a bonus in the military component). Shelters are assumed to be uniformly distributed among the population and to provide an average of about 6 psi blast protection. Fire is not considered.

c. Results and Discussion

The estimated number of fatalities resulting from optimized antipopulation attacks is presented in Figure 12. The data show the estimated reduction in fatalities that could be obtained either through intelligent use of existing structures or through the use of shelters with a protection factor of 100 by the entire population. In both cases, all shelters are assumed to be fully used. These data indicate the following: (a) as few as 200 MT delivered on cities (100 MT fission in 1 to 20 MT quantities) could cause about 30 million fatalities with fallout shelters used fully by all people, and over 50 million fatalities with no shelters; (b) with estimated 1964-65 USSR delivery capabilities, fatalities without shelters could reach 80-90 per cent of the population, and even with fallout shelters could reach 50-75 per cent; (c) considering blast and fallout effects only, fallout shelters (with an average of about 6 psi blast protection) could prevent the death of about one-fourth of the population.

Estimates of fatalities resulting from counterforce attacks on the

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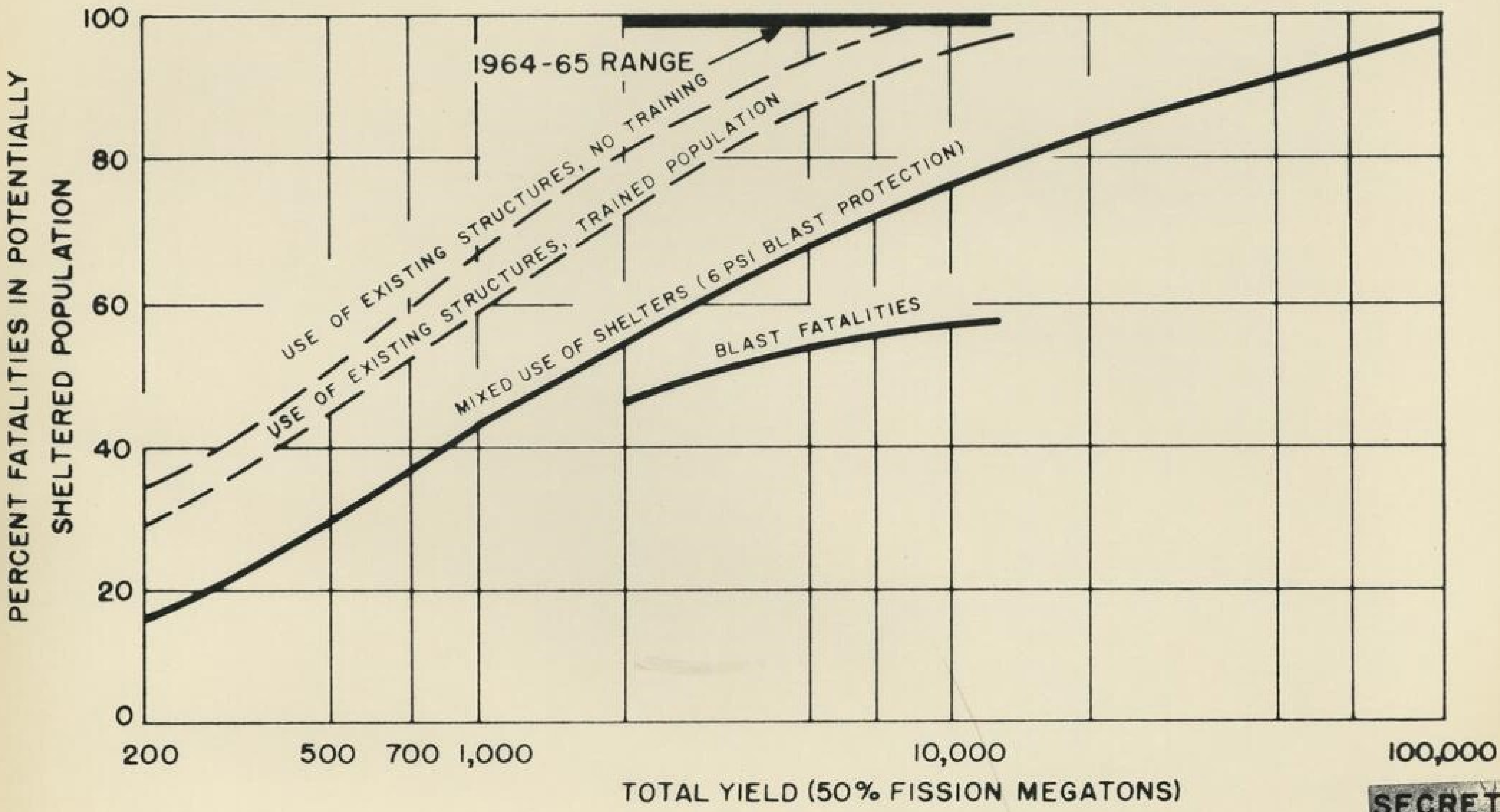

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Figure 12. The effectiveness of shelters in reducing fatalities in optimized antipopulation attacks. Fallout shelters in existing structures are assumed to afford an average of 6 psi blast protection. Mixed use assumes that part of the population is trained, while use by a trained population assumes optimal utilization of existing structures.

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U.S. (i.e., attacks intended to minimize U.S. second-strike capability) are shown in Figure 13. Note that cities are not deliberately targeted. These results suggest that for an enemy attack confined to strategic forces and avoiding cities, fallout shelters would save a very large fraction of the population in fallout areas. It is conceivable that weapons would be aimed only at critical counterforce targets (principally strategic striking forces), and with a deliberate attempt to minimize casualties. If this were done the number of casualties could be much lower than for the broader "counterforce" attacks which include targeting of both air defense and command and control. The distribution of burst points for these broad counterforce attacks was assumed by WSEG to be comparable to the distribution that would occur if weapons were randomly dropped with uniform probability over the entire country. Also, the casualty levels per weapon dropped were assumed to be nearly identical to the levels that would be obtained by such a random attack.

If weapons were aimed only at strategic delivery systems, the pattern of burst points would of course be much less uniform, and much of the fallout would be in areas of low population. Such pure counterforce attacks would produce a much lower level of fatalities because many populous parts of the country would be scarcely affected.

In all of the WSEG curves shown here, all weapons are assumed to be surface burst. However, if the enemy objective were actually to minimize casualties and fatalities, then many weapons would be air burst. This could eliminate the largest part of the fallout casualties, but would increase the casualties caused by fire and blast.

Figure 14 shows the estimates for fatalities caused by mixed attacks, in which one-third of the total megatonnage is used in optimized antipopulation attacks, and two-thirds is directed to military targets. The expected intermediate behavior is shown.

Estimates of the "exchange ratio" for the cost of building U.S. shelters compared with the cost of delivering USSR missiles are presented in Figure 15. These data (supplied by WSEG staff) are based upon the WSEG 50 strategic analysis. The data show as a function of total U.S. investment in shelters what the cost of delivering a USSR missile must be if (a) the USSR is to maintain various constant fractions of death in antipopulation strikes, and (b) USSR missile costs are to equal U.S. shelter costs. Since interpretation of the significance of exchange-ratio calculations is a difficult matter, we shall discuss briefly some of the factors that should be considered in such interpretation.

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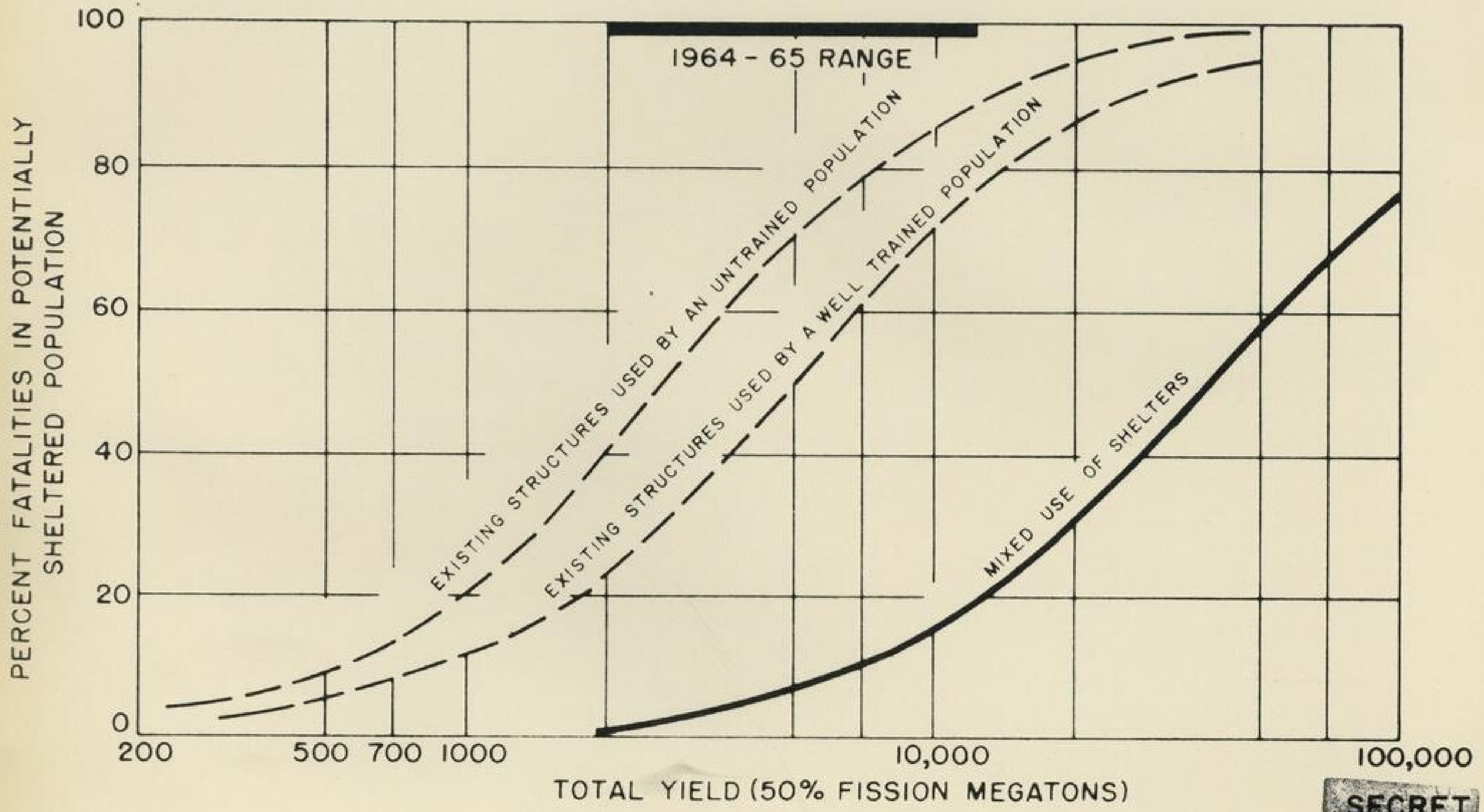

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Figure 13. The effectiveness of shelters in reducing fatalities in counterforce attacks. Blast fatalities are small and not included. Mixed use of shelters is for a population part of which is trained, while use by a trained population assumes optimal utilization of all existing structures.

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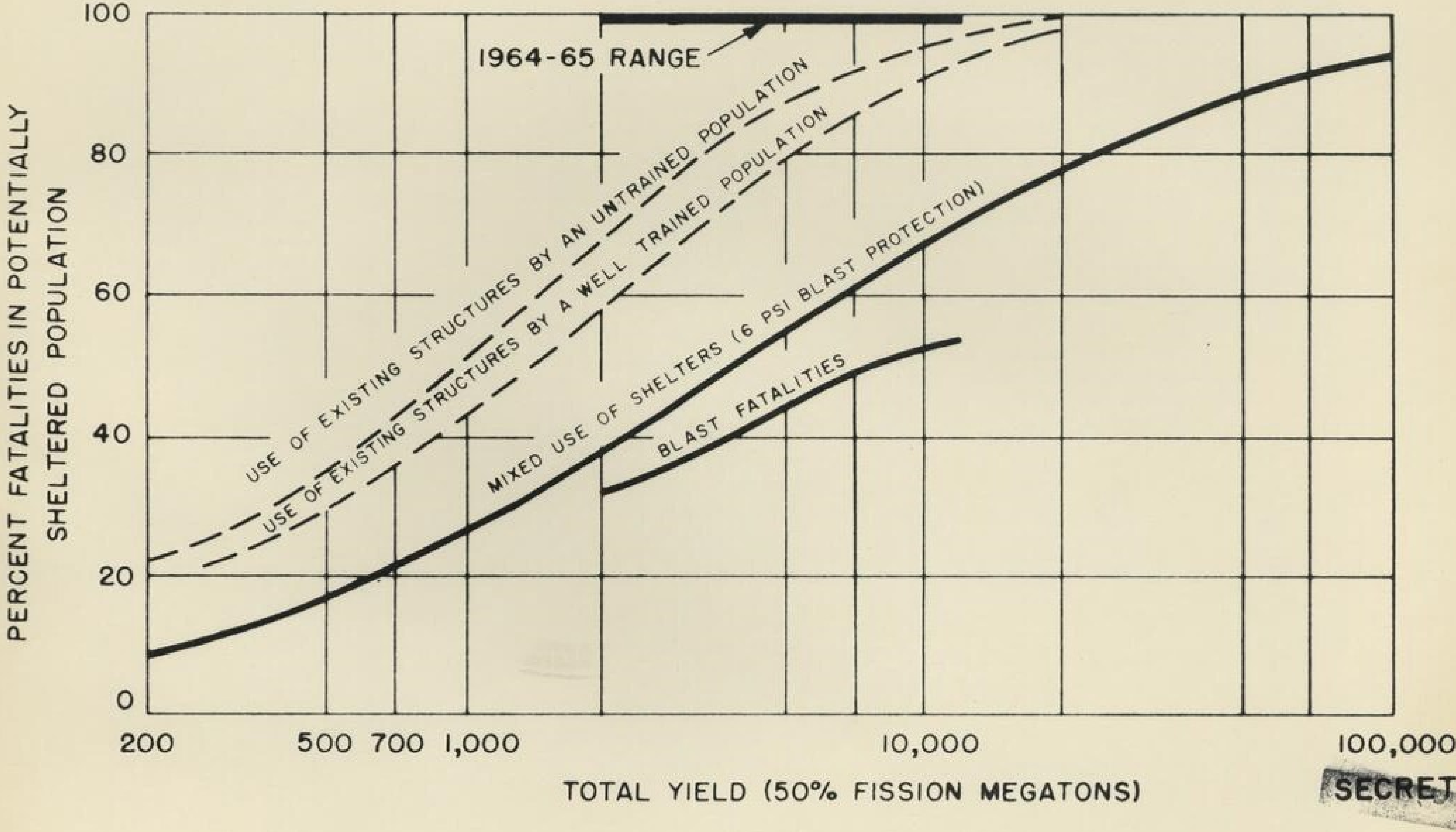

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Figure 14. The effectiveness of shelters in reducing fatalities in mixed antipopulation and counterforce attacks. Two-thirds of the total yield is delivered on counterforce targets and one-third on city targets. Mixed use of shelters is for a population part of which is trained. Existing structures are assumed to afford an average of 6 psi blast protection.

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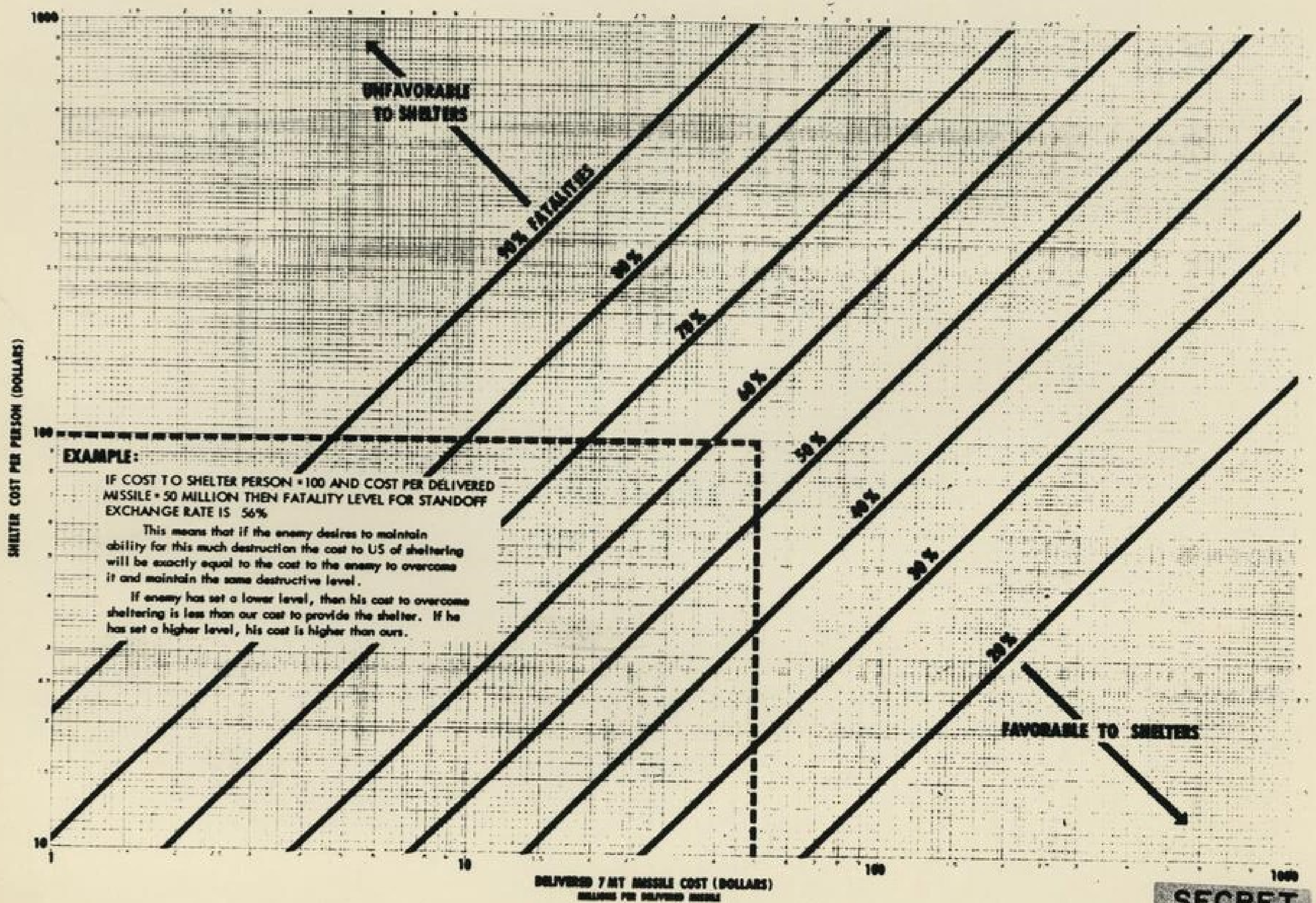

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Figure 15. Comparison of the cost of fallout shelter with the incremental cost to maintain constant levels of fatality using 7 MT ICBMs. ICBM costs are for delivered missiles and assume optimal delivery of weapons. Shelter costs assume full utilization of shelters. The points plotted designate equal ICBM and shelter costs under these assumptions. Note that ICBM costs must be increased to account for force survivability. Similarly, shelter costs must be increased to account for incomplete utilization.

3a

Exchange-ratios of the sort shown in Figure 15 are relevant only to the extent that Soviet missile posture is based on a desire to maintain a striking force capable of producing a constant level of U.S. fatalities; that is, only to the extent that Soviet missile posture is not influenced by such other factors as, for example, (a) the deterrent value of European deployments, (b) the desire for a first-strike capability, (c) reliance on economic damage as a deterrent, etc. In addition, it is important to note that equal cost to the U.S. and USSR does not imply equal economic burdens to the two countries, since the USSR is already spending three times as large a fraction of its (smaller) Gross National Product on defense as is the U.S.

If we consider the case of a hypothetical U.S. first strike, (the only case for which exchange ratios have substantial meaning) then it is clear that the appropriate exchange ratio would be one based upon only the fraction of the USSR force that would remain after such a strike. For example, if the survival probability of a USSR missile were 0.2, then the missile costs shown in Figure 15 should be multiplied by five; if 0.5, then the costs should be multiplied by two. Thus the exchange ratio is related to both U.S. nuclear strength and strategic intent.

In examining the question of whether the exchange ratios favor the acquisition of fallout shelters, we first consider the present shelter marking and stocking program, for which the cost per shelter space acquired is estimated to be $4. If full utilization of shelters is assumed, the data presented in Figure 15 suggest that if the USSR cost of delivering ICBMs were equal to or less than $15 million per missile, then the exchange ratio would favor this program at fatality levels less than 90 per cent. Put another way, if the USSR attempted to maintain U.S. fatalities at any level less than 90 per cent it would cost the USSR more to build the additional ICBMs than it would cost the U.S. to acquire the added shelters. Even if shelter costs were increased (say doubled) because of only partial utilization (and ignoring for the moment the fact that ICBM costs should also be increased to allow for attrition caused by a potential U.S. first strike), the shelters acquired through survey are still favored at fatality levels less than about 80 per cent. Thus these data strongly favor the marking and stocking program insofar as the exchange ratios are applicable.

More detailed examination of the data, including possible increased ICBM costs through attrition, suggest that the exchange ratio may remain favorable to shelters for even considerably more costly shelter programs. The degree of effective shelter utilization is clearly dependent on other aspects of the developing civil defense program and cannot be assessed at this time. The possible degree of missile attrition can be inferred from the impact distribu-

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tions associated with CEPs for current missiles, from well-known vulnerability data on hard sites, and from projected force levels. Although such evaluation is beyond the scope of this paper, an illustration may be useful. If ICBM CEPs are 1.0 n.mi. (or less), if reliability is equal to or greater than 0.7, and if sites are no harder than 100 psi, then a force level advantage of a factor of 3 (or equivalently a deployment in which there are three ICBMs at a single aiming point and equal force levels) would achieve the destruction required to increase indicated ICBM costs by a factor of five. For soft sites, regardless of deployment, reliability alone determines force requirements when the CEP is equal to or less than 1 n.mi.; hence if ICBM reliability were approximately 0.8 (and the missile deployment placed no more than one ICBM at each soft site), then the potential allocation of one U.S. ICBM to each site would also increase indicated ICBM costs by a factor of 5. In either this example or the preceding one (with 100 psi sites), increases in ICBM costs would be completely offset if effective shelter utilization were only 20 per cent.

The final WSEG data relate to the gains that could result if U.S. missiles and airplanes were moved to sites which are distant from population centers. The data are drawn from WSEG Report No. 61 and presented in Figure 16, which shows ranges of U.S. fatalities as a function of attack level, on targets specified by the Joint Advisory Group of JCS. A "pure counterforce" attack is assumed. Fatalities are calculated (a) for current plans for the deployment of the U.S. strategic force, and (b) for a hypothetical deployment in which the forces are sited so as to minimize population loss in such attacks. The conclusion is that, for pure counterforce attacks, resiting the strategic force (at a cost of about 1.5 billion dollars) would reduce the expected fatalities caused by blast and fallout by about one-half if the nation had no shelters, and by about one-third if the nation had fallout shelters for the whole population. This evaluation is, of course, completely inapplicable to a deliberate attack on population.

d. <u>Comments</u>

Since only blast and fallout effects were examined in WSEG 61, and since 100 per cent utilization of shelters is assumed, the potential saving of life through the use of shelters is consistently overestimated for the attack patterns used. However, for the type of attack examined, the relative importance of resiting the strategic force is probably underestimated, since resiting would eliminate the threat of blast and fire for urban areas which are close to current sites. Resiting would also ease many of the urban post-attack problems.

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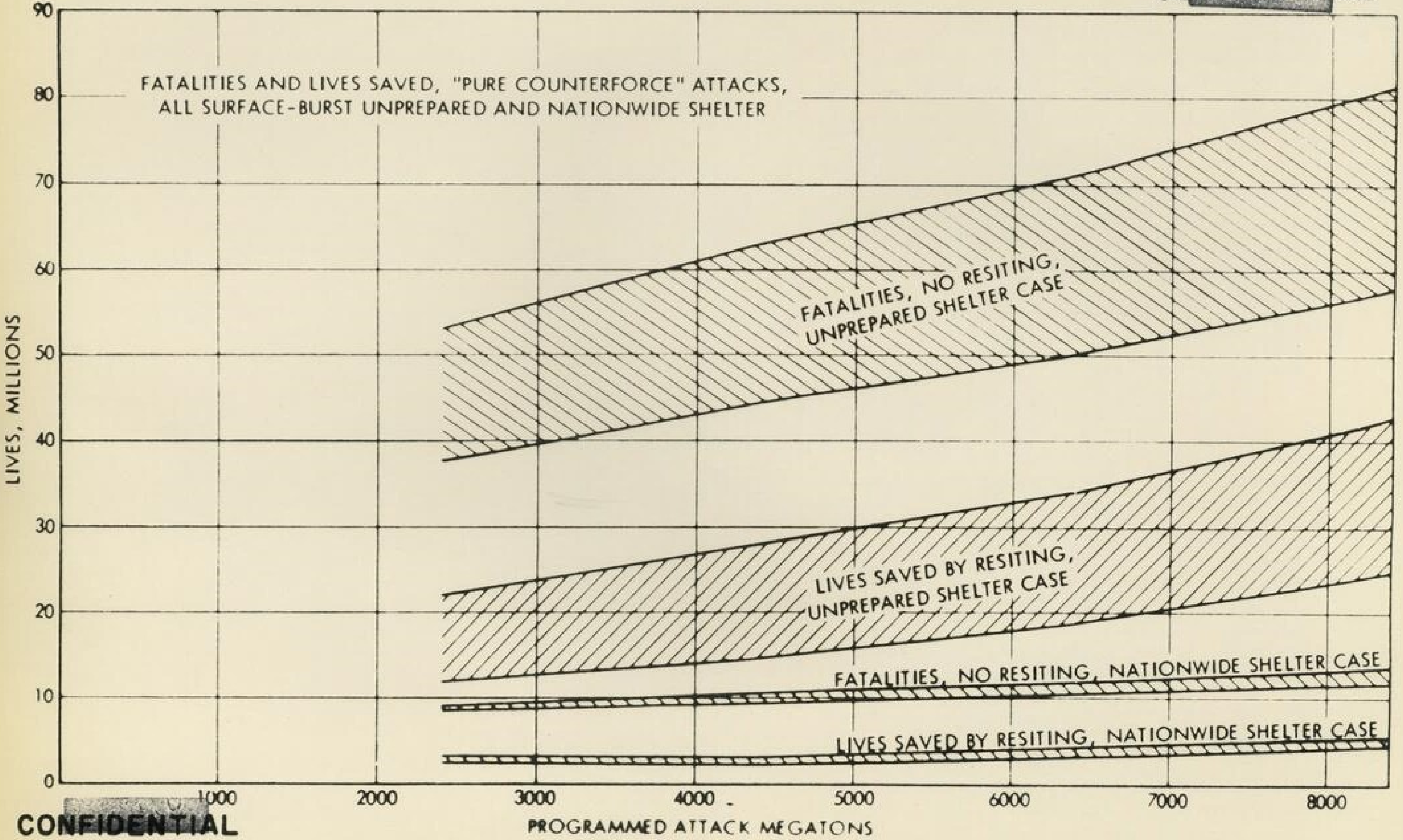

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Figure 16. The effectiveness of resiting strategic forces in reducing fatalities in "pure counter-force" attacks. (Shaded areas represent the range of parameter values for several attacks. The unprepared shelter case assumes no stocked or prepared shelters; while the prepared shelter case assumes full utilization of fallout shelter by the entire population. Resiting includes all intercontinental weapons systems.)

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3. The PAMUSA Study

a. Purpose

The problems of post-attack mobilization of the U.S. Army were examined in the PAMUSA Study as a part of an attempt to determine maximum mobilization and deployment capabilities following a nuclear attack on the continental U.S. Potential Army capabilities to support civil defense operations were also examined.

b. Fundamental Assumptions and Methodology

The attack examined is summarized in Table 2. U.S. active defenses were treated in detail, and probability assessments were made. Two specific attacks on St. Louis (one with 4 MT delivered and the other with 28 MT delivered) and a near-miss on Boston (a 5 MT surface burst on Peabody) were examined in great detail. The analysis of damage and post-attack problems is more comprehensive than in any other U.S. study. Input-output models of the U.S. economy were developed to estimate the rapidity with which Army forces could be supported by a rehabilitated economy which was able to provide austere but adequate living standards for the civilian sector. A basic assumption in this part of the study was that an adequate civil defense organization had been established and that the Army was required to assist civilian authorities only to a very limited extent.

TABLE 2

SUMMARY OF THE PAMUSA ATTACK

		Megatons		
	Targets Hit	On Target	Off Target*	Total
Canada	10	94	69	163
CONUS	213	1692	75	1767
TOTAL	223	1786	144	1930

*These arose from weapons whose carriers were destroyed on the way to their targets.

c. Selected Results

The predicted distribution of casualties with time is shown in Table 3. These data illustrate the scope of the medical, burial, and rescue problems that would have to be faced in the post-attack period. Approximately 30 million persons were estimated either to be trapped and require rescue, or to be injured and require urgent medical care. The study assumed that rescue was effected where manpower was available and where other factors permitted, and that injuries received the necessary medical care.

TABLE 3.

U.S. CASUALTIES IN THE PAMUSA ATTACK
(Time Phased, in Millions)

Distribution of the Pre-Attack Population of 188 Million	Days After Attack			
	1	30	180	365
Well	133	116	128	132
Sick and Injured*	38	34	13	7
Deaths	17	38	47	49

*Includes personnel that are sick from causes other than nuclear attack.

The predicted economic damage and recovery are suggested by the data in Figure 17. Although the sample portrayed is relatively small, representing only planned military suppliers, the qualitative nature of the curve is typical. Additional data, taken for 71 per cent of all industrial plants, indicate that 24 per cent were undamaged, 22 per cent were destroyed beyond repair, 17 per cent were damaged but could be restored in two to three weeks, 14 per cent were damaged in very heavy fallout areas where repairs were considered unfeasible for many months, and 23 per cent required from three weeks to one or two months.

The breadth of the analyses of the St. Louis and Boston attacks is illustrated by the problems which were examined: search and rescue, patient evacuation, medical, burial, route clearance, decontamination, emergency repairs, utilities, transportation, food, fuel, distribution, communications, and government. From these studies it was concluded that (1) St. Louis could

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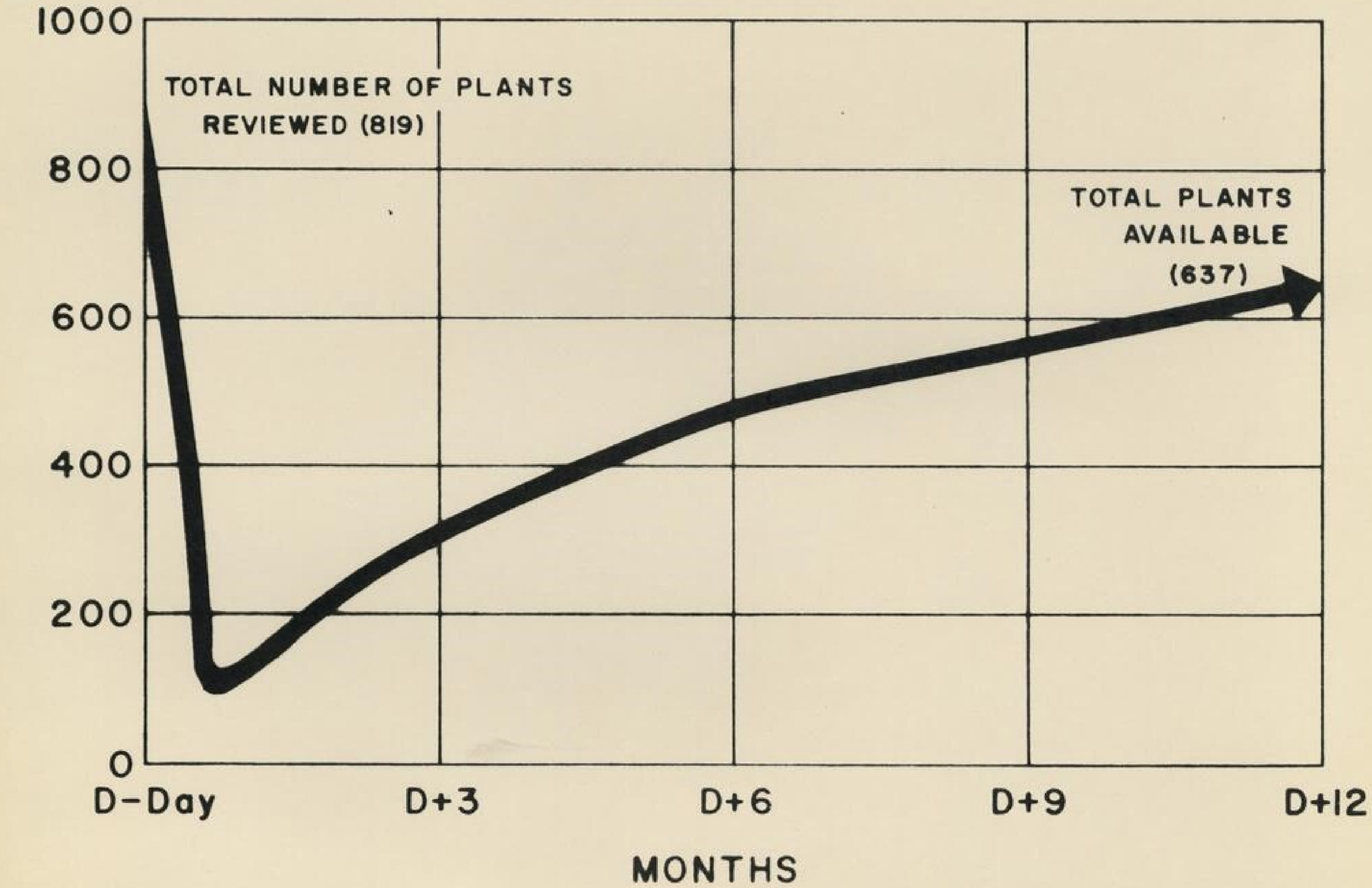

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Figure 17. The number of plants programmed to produce military goods that are capable of production at various times after the PAMUSA attack of 1930 MT (total) delivered. (Progressive reduction and recuperation of the labor force and damage to facilities are taken into account.)

not be restored after a 24 MT attack but could be restored (even to the point where it soon made a positive contribution to gross national product) after a 4 MT attack; and (2) that although the survival problems in Boston after a single near-miss with a 5 MT weapon would be quite severe because of the high ratio of wounded to well survivors, it could also be restored.

d. Comments

The assumption concerning the adequacy of the civil defense organization in 1963 and the minimal civil defense role of the Army in the immediate post-attack period are reasonable only for determining maximum Army mobilization potential. When viewed in the light of the circumstances that the Panel considers to be most likely for the time and type of attack considered, these PAMUSA assumptions seem quite unrealistic. The conclusion that rescue operations are feasible agrees with Canadian assessments, but is in sharp disagreement with very detailed British studies of assumed single-bomb attacks on Birmingham. The British analysis of post-attack damage and rehabilitation potential appears to be superior to those of all other studies examined because damage to structures and to personnel was computed on a point-by-point basis; the Panel does have serious reservations, however, about the British analysis of the rescue problem.

The PAMUSA Study was carried out for one attack level only, and it is difficult to assess the change in conclusions resulting from a change in attack.

III. DESCRIPTION OF THE PRESENT AND PROJECTED CIVIL DEFENSE PROGRAM

To a large extent this Part is restricted to a brief summary of the principal components of the current Federal civil defense program. Major aspects, especially the fallout shelter program and problems of the post-attack period are discussed and evaluated in detail in later parts . Some of the smaller components of the program, warning, communications, and damage assessment, are both described in this Part and are evaluated here in as much depth as the Panel's considerations have permitted.

A. Evolution of the Current Program

The current Civil Defense Program of the United States is an evolutionary development of programs which started roughly a dozen years ago. The early Federal Civil Defense Administration which developed the concept of joint Federal and local participation and which stressed the utility of evacuation of city populations, gave way in 1958 to the Office of Civil Defense Mobilization. The OCDM responded to the changing nature of the military threat, i.e., the recognition of the importance of radioactive fallout and the appearance of intercontinental ballistic missiles with thermonuclear warheads, by playing down the utility of evacuation and emphasizing the desirability of a civil defense program which was oriented toward fallout and blast shelters for the civilian population. Like its predecessor agency, OCDM was relatively unsuccessful in persuading Congress to support its programs. Perhaps as a result, the general public remained relatively uninterested in civil defense. This continued to be true even though the potential damage from a massive thermonuclear attack increased steadily.

Two messages by President Kennedy in May and July of 1961 sharply changed the situation. A message to Congress in May pointed to the value of civil defense as an insurance measure and announced the President's intention of revitalizing the U.S. civil defense program. Specifically he assigned responsibility for a major part of the program to the Secretary of Defense and announced that more funds would be requested for civil defense. The July message was in a press release which accompanied an Executive Order spelling out the new assignments. Both messages emphasized the President's intention that responsibility for civil defense stay in civilian hands. Both messages emphasized the desirability of fallout shelters. Congress and the public responded to these appeals and the U.S. civil defense became more vigorous than it had been for several years.

The July 1961 reorganization, in conjunction with the subsequent Executive Orders, abolished the civilian OCDM agency and transferred prime responsibility for civil defense to the Department of Defense. A new Office of Emergency Planning was soon set up to take over responsibility for plans and programs for post-attack recovery. But overall responsibility for civil defense itself as well as the bulk of the new appropriations went to the new Office of Civil Defense within the Department of Defense.

The Secretary of Defense and presumably therefore OCD was specifically directed to develop and execute:

(1) A fallout shelter program.

(2) A chemical, biological and radiological warfare defense program.

(3) All steps necessary for warning and alerting.

(4) All functions pertaining to civil defense communications.

(5) Emergency assistance to state and local governments in a post-attack period.

(6) Assistance directed toward continuity of state and local governments.

(7) Programs for financial contributions to the States.

(8) Programs for nation-wide post-attack damage assessment, including operation of actual systems.

(9) Arrangements for donation of Federal surplus property for civil defense properties.

This massive set of responsibilities clearly called for a vigorous and competent staff for the newly-created OCD.

An available Assistant Secretaryship of Defense was used to obtain a high-level director for the new office and in August 1961 Steuart L. Pittman was nominated as Assistant Secretary for Civil Defense. Mr. Pittman and his new staff went rapidly to work, transferring the major parts of OCDM to the new agency, OCD, and simultaneously developing their own civil defense program. Some aspects of the resulting program were new but in the main it was closely derivative of the program envisaged by the earlier OCDM.

B. The OCD Program

The essential characteristics and philosophy of the new OCD program are spelled out in the following quotation which comes from an OCD program statement of late 1961:

> "While the details of a civil defense program must change with changes in weapons technology, the essential elements of the program are fixed. They consist of a warning system to alert the civilian population to an imminent attack; a system of shelters equipped and provisioned to furnish protection against those effects of an attack against which protection is feasible -- i.e., radioactive fallout; and a system to provide training and equipment, so that the survivors can monitor the effects of the attack and carry out the tasks of decontamination, fire fighting, rescue, and reconstruction that are necessary to restore a functioning society.
>
> "An effective civil defense requires the participation of every citizen. It calls for advance planning at every level of government -- local, state, and national... It must be comprehensive enough to cover people living under widely different conditions from ranch houses, to apartment houses, to frame cottages ...
>
> "The responsibility for civil defense is vested by statute jointly in the Federal Government and the States ... This program will require, and is receiving, substantial Federal funds; but no program that affects every community in the United States can succeed without the clear assumption of operating responsibility by state and local government."

The principal components of the new program are:

1. A nation-wide warning system, probably the NEAR system of individual buzzers operated on the electric utility lines.

2. A nation-wide program of shelters, designed to give protection from fallout only. Emphasis on community shelters rather than on family shelters.

3. Operating responsibility in the hands of state and local governments, with Federal assistance in the form of technical help and matching funds for certain programs.

A tabulation of the budget estimates for the fiscal years 1962 and 1963 gives further insight into the program.

TABLE 4

Budget Estimates, Office of Civil Defense

	Budget in Millions of Dollars	
	FY 1962	FY 1963
Operation and Maintenance		
Warning and Detection	$ 26.9	$ 46.2
Emergency Operations	22.5	33.5
Financial Assistance to States	21.2	32.0
Management	12.2	14.6
Shelter, Research and Development and Construction		
Shelter Survey, Marking and Stockage	140.1	56.0
Shelter Incentives	--	460.0
Shelter in Existing Federal Buildings	17.5	35.0
Research and Development	15.5	17.8
Total	$ 255.9	$ 695.0

The listed figures for warning and detection are constituted of about equal amounts for warning and for detection and monitoring of radiological fallout. Of the monies in Emergency Operations, about two-thirds are for training, education and public information, and about one-third for communications and control.

1. The Fallout Shelter Program

The great bulk of the proposed expenditures is for community fallout shelters. Modest amounts are proposed for shelters in existing Federal buildings but the two large items are for the Shelter Survey, Marking and Stocking Program and the Shelter Incentives Program. These two, along with an expected substantial private construction effort (both of family shelters in

rural areas and of community shelters in industrial plants) are designed to lead to a completed nation-wide shelter system of 234,000,000 shelters by the end of 1967. This number will suffice for the entire U.S. population, i.e., it will take care of both the day-time working period and the night time residential period. The rate of build-up and the relative contributions to the total are graphically illustrated in Figure 18.

Although it is the Shelter Marking and Stocking Program which will make the major impact during the current year, ultimately the Incentive Program is scheduled to produce the largest increment of shelters, 100,000,000 when the program is complete in 1967. The shelters from this program result either from new construction or from remodeling and are presumed to involve dual usage of the new space, for example, a newly constructed school cafeteria might be designed to also be a satisfactory fallout shelter. However, to qualify for Federal aid in construction, these new shelters must meet approved construction standards and be available to the general public. The privately constructed shelters (an estimated 60 million by 1968) need not be publicly available.

At the present very early stage, the cost of the proposed shelter program is difficult to determine with precision. OCD has crudely estimated a total cost of about $6 billion of which the Federal share is about $3.5 billion. Shelters are scheduled to be the dominant item in the civil defense programs for the next several years. Warning and detection may ultimately cost in the order of $2 billion total, with lesser amounts going to the other items of Table 4.

Other phases of the OCD program are currently taking only a small fraction of the budgets but they are nevertheless important. Virtually all research in the civil defense area is supported by OCD. The nation-wide program for radiological monitoring is being designed and developed by OCD and the detection equipment is both furnished and inspected by OCD workers. This office also has prime responsibility for developing the technical components of the public information and education program, an item of great importance for a cooperative program with a large dependence on volunteer workers. Design of the basic training program for civil defense workers is in OCD's hands. OCD also has responsibility for assisting state and local governments in the development of plans (to be carried out by local organizations) for the immediate post-attack situation.

Given that the new OCD program, although broad, is primarily one to produce nation-wide fallout shelters, it is useful to note areas which are not covered or which are receiving less emphasis. The program does not

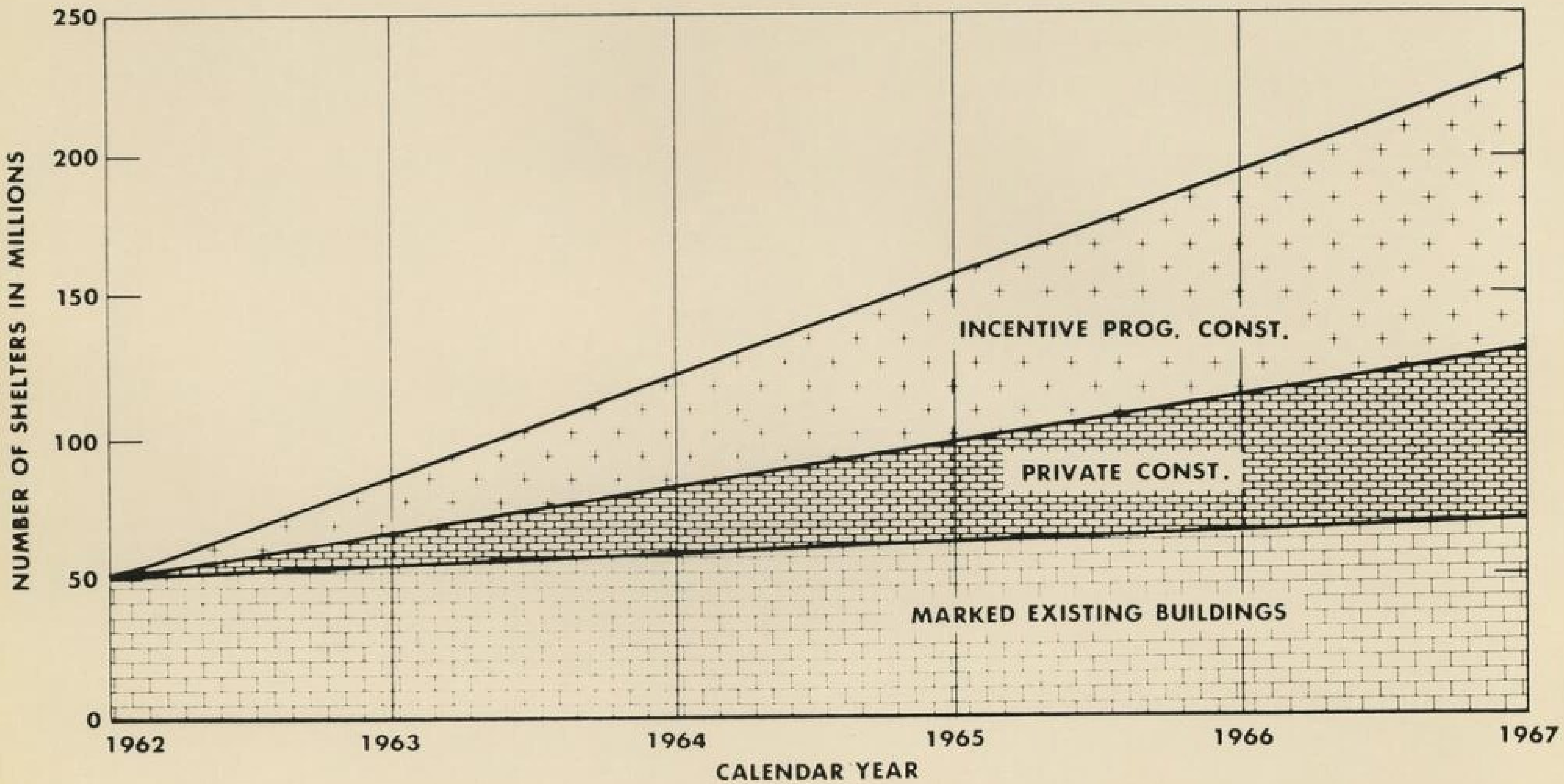

Figure 18. Planned buildup of fallout shelters.

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propose any shelters with blast and fire protection, even for areas which are likely to be targets. Nor does it yet give very serious consideration to the immediate post-attack problems of target areas: rescue operations, treatment of wounded, fire fighting, restoration of services. Responsibility for some aspects of these, particularly the long range aspects, has been given to other Federal Agencies; prime responsibility for others is assumed to be in the hands of state and local governments. Operational responsibility for virtually all phases of civil defense is explicitly delegated to state and local government agencies.

2. Warning

Adequate warning is a vital component of any civil defense program. It not only signals people to seek shelter, but also triggers the mobilization of the civil defense organization. Under current assignments, warning is a joint responsibility of Federal, State and Local Governments. The civil defense component of the Federal program is assigned to DOD, with OCD having the primary responsibility.

The systems which provide the basic data needed to generate a national warning signal are all operated by the Department of Defense. These include the various radar networks, especially BMEWS, the distant radar stations which form the Ballistic Missile Early Warning Stations, and the NUDETS system for detection and analysis of nuclear detonations on U.S. territory. Actual generation of a warning signal is done at NORAD headquarters in Colorado. The signal generated by the military command is immediately transmitted to an adjacent OCD office; from here a warning signal and also information on attack effects can be sent out both to some 450 OCD Warning Centers and an additional 50 Federal warning points. From these centers the alarm is transmitted to local governments and ultimately to the people at large. The communications system for the OCD network called NAWAS (National Warning System) consists of a pair of leased telephone circuits which are now operational on an around-the-clock basis.

Currently the final transmittal of warning to the people involves sirens and similar alarm devices. Since tests have shown these to be only moderately effective, OCD has concluded that an effective warning and alerting system must ultimately generate a warning signal in every house, apartment, factory and office. Since 95 per cent of all such places are served by electric utility companies, it appears that the electric utility lines offer the best route for the ultimate warning signal. A system called NEAR has been devised to utilize these. The idea is to have a warning signal generated upon command

in the central stations of every utility company. This signal will go out on all of the electric lines as an over-ride to the normal current. For example, signals with a frequency of say 255 cycles per second might come in as an over-ride on all 60 cycle alternating current lines. This over-ride signal will cause a household buzzer to emit a loud and distinctive noise.

The details of the NEAR system are fairly well worked out and pilot studies are now going on within several utility systems. Installation of the signal generators and the command circuits to them will be done with Federal funds and will cost about one-half billion dollars. The NEAR buzzers are scheduled to be purchased by individual families and offices. They will probably retail for from $10 to $15. Hence the overall fully-installed system will cost approximately one billion dollars of national resources, operating expenses not included.

Even though the NEAR warning system seems technically feasible and workable, there are some serious worries as to whether the overall system will reach and maintain adequate effectiveness. The first problem concerns the completeness of the installation. For the system to be maximally effective it is evident that every building, office, and apartment should be equipped with buzzers and that special provisions should be made for theaters, outdoor parks, etc. The Panel doubts whether this complete installation will occur if the buzzers themselves are to be purchased by individual families and offices; it rather strongly suspects that the installation will have to be a Federal responsibility. But even if the system could indeed be fully installed, there remain some questions of the character of the installation particularly when one recognizes that the system may need to be in place for several years before it is actually used. The worry is, of course, whether a voluntarily installed system, implying that the buzzers are plugged into normal electric outlets, can be adequately maintained. In the Panel's view simple plug-in buzzers will not be adequate unless they can be attached permanently to the outlet and provide in this case an additional outlet so as to eliminate the temptation for removal. It is in fact difficult to see how the system will be maintained adequately unless installation is initially done in a way as to make the buzzer a permanent installation and unless provisions are made for routine, perhaps annual, inspection of the buzzers. Unfortunately such changes will increase the costs of the system.

The Panel is also concerned that unless action is taken to prevent the frequencies finally adopted for the NEAR system from being used for other purposes it may be necessary to retrofit the receivers so that they would operate on other frequencies or accept severe degradation in system performance due to interference. To some extent this problem has already arisen and has resulted in a frequency change for the over-ride signal (240 cycles to 255 cycles). Consideration should be given to methods (perhaps legislation) of preventing this from happening again.

3. Communications

Communications is essential to civil defense in a variety of ways and at several levels. Federal responsibility in this area is assigned to OCD. Actually the OCD tasks are dual. One is to provide the actual communications network from central Federal facilities to a selected set of State and Local communication points. The second task is to give both direction and assistance to communication facilities at the state and local level, the overall objective being a reliable national communications system.

a. Nation-wide Networks

One segment of the OCD national network system, the leased-line NAWAS for communication of warning and of information on attack effects, was discussed in the previous section. Actually it is now proposed that all of the OCD responsibilities for national communication networks be turned over to the Defense Communications Agency and be integrated with the military communications system. Although the Panel has not investigated this proposal in detail, it appears to be both reasonable and economical. The current OCD network systems are:

(1) National Communications System No. 1 (NACOM #1)

This is a leased teletype/telephone system which is designed to be the backbone system of OCD/DOD for command and control. It links the OCD national and regional headquarters, the State headquarters and the District of Columbia. The system is operating to regional headquarters on an around-the-clock basis; the region-to-state portion is on a stand-by status which, however, is stated to be operable within one hour if needed.

(2) National Communications System No. 2

Because of the comparative vulnerability of a leased-line communications system to nuclear attack, OCD is completing a radio back-up system to cover the same units as NACOM 1. This will permit minimum emergency communication if NACOM 1 is disrupted.

b. Communications to the Public

Some national systems designed to permit communication to the public in the event of an emergency already exist. The best known of

these is CONELRAD whose operation is under direct control of NORAD. When a CONELRAD alert is initiated all general AM broadcasting ceases and only intermittent broadcasting occurs on two frequencies, 640 and 1240 kilocycles, this being done in such a way that it provides minimal navigation aid to attacking aircraft. The CONELRAD system is, of course, available to OCD for the dissemination of emergency orders.

There is also a Radio Amateur Civil Emergency Service (RACES) which enables amateur radio operators to assist various state and local communications systems in emergencies. This program has had some Federal support and is presumably in reasonable operating condition although one can assume that modest future expenditures will be needed to avoid obsolescence. No specific funds for either of the above are called for in the proposed OCD budget for FY 1963.

The OCD expenditures in this general area are directed toward assistance to AM radio stations throughout the country with particular emphasis on providing for communications in the post-attack period.

(1) Radio Equipment Maintenance

Very modest funds are proposed for maintenance of some equipment which OCD installed at selected radio stations during FY 1962. This equipment was designed to permit the station transmitters to be remotely programmed from protected Civil Defense Control Centers. Since the system is now installed the only projected further expenditures are for maintenance.

(2) Protection of Broadcast Stations

OCD plans to spend about $6 million in this area during 1963. These funds will be used to continue a program of insuring that AM radio transmitting stations are available for use during emergency periods. The expectation is that 900 additional AM stations will be equipped for this emergency use during 1963; this is 20 per cent of the Nation's AM stations.

The program consists of three parts: (1) installation at Federal expense of emergency power generators if these are not already available; (2) construction of a fallout protection area at the transmitter for the engineering and maintenance personnel there; (3) provision for an NAWAS line to the station to give it direct access to the warning information. The goal of this program is to have a sufficient number of protected transmitter

stations so that the entire population of the Nation is within range of one or more of them. When the system is complete OCD will have a direct access to the entire public from its NAWAS network.

(3) Radio Communications With Broadcast Stations

OCD expects to spend about $600, 000 during 1963 to continue its program of establishing backup communication links between protected Civil Defense Control Centers and the special protected transmitter stations discussed in the section above. These are scheduled to be radio circuits and will supplement the conventional wireline linkages which now exist. The ultimate goal is to have radio linkage to all of the transmitter stations which are part of the protected national network.

c. Role of Communications in Civil Defense

The two most obvious needs for communications in a civil defense program are for dissemination of warning and for command and control. The problem of warning is a reasonably straightforward one although it must be noted that there are various levels of warning which may be involved, ranging from strategic warning to the final warning of an accomplished attack. Some facets of the warning problem are discussed briefly in Part V. However, the overall problem of communications for command and control is a decidedly more complex matter and is deeply involved in the organization of the command and control system itself. Since for most phases of civil defense activity command and control is relegated to state and local governments, the Panel has not investigated this in any detail. It has, however, become increasingly conscious of the fact that tight command and control will be essential during the post-attack phase and that communications will be vital for this. As further studies are made of the problems of the post-attack period, it is virtually certain that further development of the command, control and communications problem will play a major part.

4. Damage Assessment

Just as it is important in any civil defense program to provide for communications and for dissemination of warning, so is it important to make explicit provision for the assessment of the damage which results from a nuclear attack. Information on damage is essential to effective rescue and medical care in the period immediately following an attack; it is of almost equal importance in the longer range problems of restoration of services and of post-attack recovery. OCD has prime responsibility in this area and has

requested $2.5 million for its FY 1963 program; however, several other Federal Agencies, including OEP in particular, have significant roles. The overall damage assessment program consists of three parts: pre-attack vulnerability analysis; immediate post-attack damage estimates; refined and more detailed post-attack assessments.

Pre-attack vulnerability analysis requires the establishment of a data base (i.e., the collection and storage of information relative to production facilities, quantities, locations, etc., of resources and targets) and the estimation of the effects of various levels of attacks. The data base required for immediate post-attack operations (OCD) and for resource planning and management (OEP and the other Federal Agencies) are somewhat different but overlap considerably. Analyses are needed for pre-attack planning, program evaluation, and vulnerability reduction. Available studies are discussed in Parts III, IV and VII.

Immediate post-attack damage assessments are required as a basis for continuity of government and for immediate civil defense operations. According to present plans, they are to be obtained by computer routines based upon the meteorological data provided by the Weather Bureau, aerial reconnaissance data to be provided by the Tactical Air Command, and the data on nuclear detonations to be provided by NORAD.

Post-attack assessments are also required for strategic evacuation and other OCD operations, resource allocation and control, and for the performance of all other emergency and recovery functions of Federal and State Governments. These assessments can come later in time and will be based upon refined data from the previously cited sources, reports from official sources, and from on-site inspections by the agencies concerned.

a. Status of Current Programs

The data base has been continually improved over the past five years, however, it is still grossly inadequate for many of the purposes that it must serve. Typical examples of deficiency are as follows: there are no data indicating either the level or disposition of wholesale supplies of food; there are no data indicating the location and quantity of materials needed for emergency operations in local communities; in the power and fuel area, data are available indicating the location of sources of storage of petroleum with capacities greater than 25,000 barrels, but no data on storage facilities of lesser capacity. One million dollars are requested in the FY 1963 Budget to improve the data base.

Pre-attack planning, particularly in the area of vulnerability reduction, and program evaluation have suffered greatly because of the inadequate data and restricted analysis. Comment on these areas can be summarized by indicating that although proposed programs will help with some problems, at present it appears virtually impossible to estimate with adequate accuracy either the overall state of preparedness or the national potential for recovery. Such important factors as the quantity and distribution of essential products (including food); considering the interrelationships among the various components of our resources, the time required and the method by which distribution could be restored after various levels of attack; and the type and general level of support required from the Federal Government in the immediate post-attack period are examples of needed assessments.

b. Vulnerability of Damage Assessment System

The Panel was impressed with the vulnerability of the damage assessment system itself, principally because its activities are focussed at four central locations. The major activities occur at the National Damage Assessment Center (NREC) which is located at the main classified site. This center is relatively hard (50 psi) at the present time and it is anticipated that the hardness will be greatly increased in coming years. The data base, a computer and computer routines for making early damage estimates are available at this site. Representatives from all major Federal Agencies are available there to assist in damage assessment. During an emergency these are to be augmented to carry out the functions of Federal Agencies.

Even though the computer routines do not adequately consider resource interrelationships and other system aspects, they and the data base are reproduced at three alternate sites. These, however, are now above ground and soft (3 psi); consequently, the capability of the Nation to assess damage could be greatly reduced by the destruction of one hard point target and three soft targets. *

Over the past years, OEP has attempted to make these locations secure through secrecy, and although all sites and the location of all sites remain classified, the existence of these classified locations is public knowledge. The effectiveness of the secrecy program is somewhat doubtful. There appears to be a need for a thorough review of the damage assessment system.

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* Damage assessment at a greatly reduced efficiency -- hand assessment as compared with computer assessment -- could be accomplished at the eight OEP regional centers. However, all of these are also soft at the present time, though 2 hard sites are under construction.

C. Programs of Other Agencies

1. Rationale of Responsibility Assignment

Following the assignment of major civil defense operating responsibilities to the Department of Defense, the President delegated various other emergency preparedness functions to the major Departments, State excepted, in a series of executive orders issued February 14, 1962.

These orders appear to have been based upon the following principles:

(1) Emergency preparedness, including preparations for civil defense, is an essential and integral part of each agency's continuing program and it is not feasible to segregate funds for such activities.

(2) Emergency planning is needed with respect to (a) limited war, (b) a period of nuclear attack on the United States, and (c) the rehabilitation of the economy following a period of nuclear attack.

(3) Insofar as emergency preparedness programs relate to civil defense, they will be carried out "in consonance with national civil defense plans, programs and operations of the Department of Defense."

(4) Responsibilities for limited war and post-attack rehabilitation will be delegated to appropriate agencies under the leadership and coordination of OEP.

(5) The Director of OEP, in keeping with the new role of the Agency, will "advise and assist the President in determining policy and assist him in coordinating the performance of functions under these orders with the total national preparedness program."

(6) Programs developed by Federal Agencies should be on the assumption that the developing agency will also be the implementing agency.

2. Agency Programs

a. Scale of Non-DOD Civil Defense Activity

Although it is impossible to separate civil defense preparations from those for defense mobilization and for other emergency activities that could occur in limited war as well as in general war, the scale of effort devoted to non-DOD civil defense activities can be fairly well established by examining the budget allocations. A summary of the estimated FY 1963 obligations of the Federal Agencies for the combined functions was prepared by OEP and is reproduced as Table 5.

The total FY 1963 Fund requests for all non-DOD agencies is seen to be about $59 million for the combined functions. This should be compared with the DOD request of $695 million of which $569 million are for shelter and related programs and $126 million are for maintenance and operation. Thus, the effort devoted to fallout shelters is at least 10 times as large as that to all the non-DOD programs. Whereas the requests for the activities within OCD have more than tripled between FY 1962 and FY 1963, those for other activities have only marginally increased, particularly if the medical stockpile which accounts for $40 million of the HEW FY 1963 funds is eliminated.

Although 14 agencies have received specific preparedness assignments, major programs are assigned to the Departments of Agriculture; Commerce; Health, Education and Welfare; Interior; and Labor. The Office of Emergency Planning has the particularly important task of coordinating the planning of these agencies, and thus planning for national recovery. The estimated budgets for the agencies concerned are listed in Table 5; subsequent paragraphs give a very brief summary of the more significant programs.

b. The Office of Emergency Planning

(1) Scope of responsibility assignment. The Office of Emergency Planning's principal responsibility is assisting the President in the planning and administration of the Nation's non-military defense. It is also responsible for the preservation, or reconstruction, of national political and economic structures and systems, providing guidance and assistance to States and local governments in post-attack planning, administering disaster relief, creation and maintenance of emergency stockpiles, and for planning for national and international telecommunications.

TABLE 5

Budget Estimates
Civil Defense and Defense Mobilization
Functions of Federal Agencies

Department or Agency	Budget in Thousands of Dollars FY 1962	FY 1963
Department of Agriculture	$ 344	$ 305
Department of Commerce	2, 485	2, 801
Federal Aviation Agency	121	200
Federal Communications Commission	15	68
General Services Administration	--	--
Department of Health, Education and Welfare	37, 347 a/	42, 106 a/
Housing and Home Finance Agency	161	250
Department of the Interior	429	487
Interstate Commerce Commission	70	175
Department of Labor	978	1, 285
Post Office Department	11	11
Treasury Department	67	80
Small Business Administration	16	42
Veterans Administration	17	17
Office of Emergency Planning	7,930	11,000
Total	49, 991	58, 825

a/ These estimates include stockpile management and procurement.

(2) Major activities. The major activities of the OEP are: executive direction, emergency planning, resources and production planning, and research and development.

(a) Executive direction. This activity provides staff assistance to the President in coordinating the non-military defense program; for work with Federal Agencies in attempting to mobilize State, local and private participation in non-military defense, and liaison.

(b) Emergency planning and program review. Federal, State, and local emergency plans are reviewed and evaluated under this activity in order to assist in maintaining continuity of government, coordinating overall planning for emergency censorship, administrating disaster relief, coordinating resource evaluations and non-military policy formulation. Basic national emergency planning documents such as the National Plan for Civil Defense and Defense Mobilization and Plans C and D Minus are developed.

(c) Resource and production planning. This activity develops operating plans to stabilize the economy and manage national resources under various emergency conditions. Plans are also developed for the restoration and rehabilitation of essential physical facilities after attack.

(d) Research. OEP undertakes research (principally through contract) to support the previously cited functions. Research to support mobilization planning consumes half ($750, 000) of the OEP research budget, with the remainder going to support the continuity of government and other programs.

(3) Scale and distribution of effort. The funds requested for FY 1963 are presented in the following table. These reflect the planning orientation of the Office.

OFFICE OF EMERGENCY PLANNING

	1963 Estimate
Executive direction	$ 2, 944, 300
Emergency planning	1, 959, 800
Resources and production planning	1, 595, 900
Civil defense	--
Research and development	1, 500, 000
Post-attack planning	3, 000, 000
Total	$ 11, 000, 000

(4) Program Development. The program of this recently established Office is not reviewed in detail here. Under its current leadership progress is being made in developing capabilities for the coordination of planning and for program evaluation and review. The adequate performance of these tasks is obviously central to the development of a viable national preparedness program, as is that of planning for the continuity of government, a task also assigned to the OEP and discussed in Part VI. Since programs in these areas must inevitably involve participation and coordination with many of the other agencies, the development of agreed and workable plans will undoubtedly be a difficult operation.

c. Programs of Other Departments and Agencies

The responsibilities of other Agencies are described in greater detail in Annex "B"; here only the more important features will be considered, and these only for the departments having major emergency preparedness functions. The present comments on these programs are scaled more to the magnitude of the current effort than to the importance of the functions to be performed. As will be seen, these programs form an integral part of the overall civil defense system and are extremely important with respect to survival following an attack. No attempt will be made to separate the effort being devoted to planning for limited war contingencies from that devoted to civil defense following a nuclear attack, this is not feasible. However except for HEW most of the programs to be considered appear to be oriented more towards limited war than towards the consequences of a major nuclear attack.

(1) The Department of Agriculture. With a total FY 1963 request of $305, 000 the USDA is attempting to develop and coordinate national programs covering food production, food management (at the wholesale level), rural fire defense and timber production, rural civil defense information and assistance, and rural defense training and fallout monitoring. The rural information and assistance program is allocated $60, 000 to carry out the Federal responsibilities associated with informing the rural population on most aspects of civil defense and of developing programs to advise them of desirable actions after an attack. The food management program is allotted $50, 000 even though there is no assurance that the distribution problems (consequential even when the total supply is adequate) in the post-attack problem are as yet solved. There is very little programmed research designed specifically to support these programs. The scale of effort devoted to these programs is not commensurate to magnitude of the problems they attempt to solve.

(2) With its budget of $2.8 million, the Department of Commerce is responsible for the production resources of the Nation during all emergencies

and for the coordination and control of transportation. Its principal programmed activity ($1.8 in FY 1963 funds) is concentrated in the Business and Defense Services Administration which also has the important job of keeping priority peacetime production on schedule and hence devotes relatively little effort to post-attack problems. Considerably smaller efforts are being devoted to such important items as emergency control of transportation ($0.2 million), and the provision of fallout forecasts by the Weather Bureau ($0.1 million). In general, all planning for the restoration of production, control of transportation and provision of fallout data following a nuclear attack seems to be in an early stage of development.

(3) The Department of Health, Education, and Welfare. With FY 1963 funds of $42.1 million, the Department of Health, Education, and Welfare is developing programs to provide emergency health, welfare, and educational services. Unlike other non-DOD agencies the major share of HEW emergency funds is devoted to emergency functions in general war. The medical stockpile program accounts for 40 of the total of 42.1 million dollars requested; however, even these funds will not complete the purchase of emergency hospitals and drugs, nor will they permit complete decentralization down to the local levels of those already purchased. (Currently there are about 3000 prepositioned hospitals and 7000 first aid kits prepositioned in local areas. They are being provided with a 30-day expendable supply.) The remaining major programs relate to the coordination of planning $150,000) and education for both medical personnel and the public. The latter is particularly significant since HEW seeks ultimately to train 50,000,000 Americans in medical self-help.

(4) The Department of the Interior. With funds of the order of $487,000 per year, the Department of Interior is developing emergency plans and programs for electric power, petroleum and gas, solid fueld, and minerals. Energy is a critical requirement in the post-attack period; however, these programs provide only advice and technical assistance to industry and to the States. The programs are to be implemented by groups of industrial executives who form a "reserve" and will become Interior employees. The scale of effort and post-attack general program orientation seem inconsistent with the critical requirement for energy in and after nuclear attacks on this country.

(5) The Department of Labor. With a budget request of about $1.3 million, the Department of Labor is developing programs for the emergency management of the labor force, both in general and limited wars. Current programs provide for technical assistance to States, seek to establish built-in manpower readiness at the local level, and continue the collection and analysis of manpower data. The provision of these data and post-attack damage assessments to appropriate authorities appears to be the principal Department of Labor function.

IV. FUNCTIONS AND RISKS OF CIVIL DEFENSE

A. Civil Defense as a Part of the Total National Posture

It will be apparent from what has gone before that civil defense in its detailed workings is complex. It consists of many interrelated components; varying degrees of emphasis might be assigned to any of these in designing a specific civil defense program. Essentially, however, the totality of these measures and components amounts to a para-military form of defense whose function is to save lives and to enhance the possibilities of national survival under conditions of a thermonuclear attack on the U.S. It is thus on a par with -- and must be considered in relation to -- the other major elements that make up the Nation's military and political position. These include our strategic forces, our active defenses, our activities in arms control, our "cold war" posture, and many other elements. Once civil defense has been set in this sort of general context, it is proper to ask what functions it can perform for the Nation in furthering its peacetime goals, what measure of protection it can afford in the event of attack, and what risks of a military, political and social nature may be attendant on its development.

It is ultimately necessary to measure the effectiveness of a specific civil defense program against the yardstick of a full-scale thermonuclear attack. However, there is a good deal that can be said concerning its utility under less demanding conditions. For example, a civil defense program may have a certain usefulness in the Cold War, in that it emphasizes the U.S. determination to protect itself in every way possible, and underscores our emphasis on the value of human life. Alternatively, in an arms control environment in which force levels were severely restricted, a full-scale thermonuclear attack would not be massive, and civil defense might play a more significant role. There is, of course, another side to the coin: a civil defense effort of magnitude might well appear provocative to the USSR and to the world at large. Thus it might provoke Soviet military or political responses deleterious to both the safety and the long-range goals of the U.S. What these responses might be are discussed later in the section on "Risks."

Again, it has sometimes been argued that in the Cold War, civil defense would contribute to U.S. deterrence against strategic attack, and thus in some sense strengthen the strategic balance in our favor. Strictly within the context of large scale strategic attack and response and considering the projected force levels and the potential effectiveness envisioned for civil defense, the deterrent role for a civil defense program appears to be a minor one.

Deterrence against major strategic attack is based mainly on fear of the effects of thermonuclear reprisal, and the possibility and great fear of such reprisal seems to be little affected by the existence in the attacked nation of a general civil defense program. Such deterrence is principally served by the protection--through hardening, dispersal, or other means--of the strategic retaliatory forces and of their command elements.

Other situations short of total war can be imagined in which civil defense measures can serve a useful function. However, it is in the total war environment that these measures are most severely taxed. The next section is devoted to an analysis of what sorts of attacks might be anticipated in such a war, and what effectiveness various civil defense measures might have in the face of such attacks.

B. Effectiveness of Civil Defense in Various Attack Situations

1. Introduction

The effectiveness of a civil defense program is extraordinarily sensitive to a number of parameters--some associated with the particular emphasis of the program itself, others with the nature and intent of the attack. By all odds the two most important parameters are intentions and the weight of the attack--the total megatonnage delivered on the U. S. It must be said at the outset that both common sense and the relevent studies indicate that in the case of some very heavy attacks--say several tens of thousands of megatons on cities--no civil defense measures of any of the sorts now contemplated will be of much avail. The possibility of attacks of this magnitude over the course of the next decade cannot be discounted. However, it seems useful to probe those situations in which civil defense would have an important impact on national survival. To this end, it seems worthwhile to categorize certain broad classes of attack patterns and to explore briefly and qualitatively the relation of each to the various components of civil defense. In the course of the discussion it is convenient to have at hand some sort of quantitative measure of the effectiveness of a civil defense program or of its components. That adopted here will simply be the saving of human lives, which is certainly the most important single criterion that can be applied though not the only one of importance.

2. Relation of Civil Defense Measures to Attack Type

The enemy's strategic force consists of a mix of missiles and aircraft, and his target system of a mix of military installations and of urban-

industrial complexes. The situation can be arranged in the form of a matrix:

Vehicles \ Targets	Military	Urban
Missiles *		
Aircraft		

* ICBMs and submarine launched missiles are included.

One can then roughly specify an attack by checking one or more boxes of the matrix, a check signifying that a sensible number of vehicles of that type are used against that kind of target. (As more military targets are listed, there tends to be great overlap between urban and military strikes.)

There are certain general remarks that can serve as partial guides to evaluating the various components of civil defense against the various attack types that can be visualized from this matrix.

Against those military installations capable of a rapid counterstrike the enemy must use missiles. Any initial counterforce objectives he may have cannot be met by attacking SAC bases or ICBM site installations with aircraft. Consequently, in a mixed military-urban first strike attack he can assign only those missiles to cities that can be spared from the counterforce role. For the next few years, then, if current intelligence estimates are to be credited, the urban attack would be made principally with aircraft. This situation can be altered in the course of time if the Soviet bomber force is phased out in favor of missiles.

The relevance of the above remarks is in connection with warning time, which in turn affects the type of sheltering that can be usefully employed. In the case of bomber attack there may be as much as several hours of warning. This is quite adequate even to get people into blast shelters in the likely urban target areas, if such shelters are provided. In case of missile attack, warning times, in the absence of strong strategic indicators, or in the event of a ragged attack, may be thirty minutes at most (if MIDAS becomes operational) or perhaps even fifteen minutes or less (BMEWS). It is debatable what proportion

of the threatened urban population could enter into blast shelters in such a short time. If, then, heavy missile attack on the cities is anticipated, and if warning time is short, urban blast shelters are unlikely to be very useful.

In the case of fallout shelters, the matter of warning is less urgent, but still important. The pure counterforce component of an enemy strike would kill largely by fallout, and to a far lesser extent by blast and fire. For the urban component of the strike, blast and fire would be the major cause of fatalities.

In the light of these remarks, one can go on to examine certain prototypical attack patterns and draw at least qualified conclusions concerning their relation to certain types of civil defense efforts.

a. Coordinated All-Out Attack

This represents a carefully planned enemy first strike. Its objectives would be first to break the U.S. strategic reprisal capability, and second to cripple the Nation by destroying its cities and industries. A high order of capability on the part of the enemy is postulated here, since the attack weight must be such as to preclude the possibility of serious reprisal against himself. Such an attack would impose the most serious burdens on all of the machinery of civil defense. Since the strike would be large, fallout shelters could save many lives in the rural and suburban areas. The utility of blast and fire shelters in cities would depend on warning time. Organized rescue, fire control and medical care would play a critical role, and would be carried on under the most difficult and chaotic conditions. Very effective and very extensive organization of the immediate post-attack period would be required if those who survived the shelter period were to be able to help themselves and the Nation get back on their feet. However, with a very high level of attack, or with an emphasis on salted weapons, high megatonnage air bursts and even chemical and bacteriological weapons, no protective measures could be very effective, and the Nation would be nearly certain to undergo severe transformation.

b. Counterforce Strike

As noted, earlier, in a pure counterforce strike, fallout is the major killer. Consequently for this type of strike, the utility of fallout shelter is at its maximum. Certain U.S. strategic thinking embraces the notion of "careful" counterforce, wherein a deliberate attempt is made to minimize the civilian casualties. Such tactics would be hard for the Soviets to carry out,

even if they wanted to, since the degree of co-location of military and urban targets in this country is fairly high. Nevertheless, fallout shelters would, in this case, substantially increase the Soviets' ability to discriminate between military and civilian targets if that were their intentions.

c. Uncoordinated Preemptive Strike

A Soviet conviction, however erroneous, that the U.S. had mounted an attack might lead them to attempt a prior application of strategic force against the U.S. Since a sense of desperation is implied, the attack might be relatively uncoordinated, and -- most importantly -- it might be of lesser total weight than in the coordinated all-out attack and yet still be directed primarily to strategic striking forces. Consequently, civil defense measures could be far more effective than in the coordinated all-out attack. In addition, considerably longer warning times might be available in a situation of such obvious tension.

d. Urban Second Strike by Remnants of a Damaged Force

The origin of such an attack would lie in some kind of U.S. preemptive strike against the USSR, involving, as it would have to, a strong counterforce component. The response might be expected to be considerably weakened in weight by the damage wrought, and perhaps somewhat ragged in execution. However, it might well be primarily punitive in character and primarily directed at urban targets. Thus blast and fire could be expected to be major killers. The effectiveness of urban blast and fire sheltering might be higher than in the case of a deliberate Soviet first strike, since adequate warning would be available even with respect to missile delivery, and since the attack weight is presumably diminished. Fallout shelter would be relatively ineffective by itself.

3. Likelihood Associated with Various Attack Situations

What can be said about the relative likelihoods of these various possible contingencies? It is the Panel's conviction, based on reasoning which need not be rehearsed here, that the USSR (whatever their wish in the matter) is forced to rely on their strategic forces in a deterrent role only, and will continue to be forced to follow such a strategy for a number of years. The U.S. posture is closer to a first strike potential, but expected USSR retaliation would still be substantial; for many reasons the use of the U.S. strategic force in any but a deterrent role is an extremely remote possibility.

It thus seems very unlikely, therefore, that either side will feel itself in a position for the foreseeable future to mount a coldly premeditated first strike against the other with the expectation of escaping with an "acceptable" level of damage to itself. If this is so, the only major attacks the U.S. would expect to suffer would result from a breakdown of deterrence due to "pre-emption" by one side or the other. This means a conviction on the part of that side, based on panic or miscalculation, that his adversary is about to strike him, and that he will be at least somewhat better off if he beats the adversary to the punch and delivers the first blow himself. In this event the U.S. could expect either a relatively weak* preemptive strike with a strong counterforce component, or a scattered punitive reprisal strike depending on who attacked first. It is the view of the Panel that these two contingencies represent the two major attack patterns against which the effectiveness of a civil defense program is to be measured. It is important to emphasize that these two attack patterns are considered of low probability. However, as pointed out in the Introduction (Part I), the stakes are high even if the odds are low. Therefore, a lesser yardstick should not be used in evaluative studies.

A quite different approach to civil defense requirements can be made by abandoning any effort to foresee specific nuclear engagements. Instead the point is made that without disarmament or arms control we face a future in which nuclear weapons will multiply and diffuse. In such a world, accidental or ambiguous nuclear explosions, abortive attacks, attempted blackmail by minor nuclear powers, and numerous other contingencies as yet unforeseen can be expected from time to time. It is, therefore, a natural concern to provide reasonable insurance against a wide range of possibilities. What might be done in this regard may well be the same as some of those civil defense preparations taken against a more specific threat. But in the sense projected here the defense is more passive and may be considered as general insurance against a spectrum of dimly perceived risks. While this approach provides no quantitative basis for judgment, it suggests that those countermeasures which are most common to a number of attack patterns and situations should have the greatest priority.

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* This term must be interpreted with care. In the event of a continuing arms race, both sides could remain in a position of stalemate while the strategic stockpiles continued to grow. The force of a preemptive strike must be judged with this consideration in mind.

C. Some Quantitative Estimates of the Effectiveness of Fallout Shelters

The foregoing discussion has been largely qualitative in character. About the only quantitative calculations that exist concern the effectiveness of that component of civil defense currently receiving the greatest emphasis -- namely the fallout shelter program. It must be borne in mind that such calculations generally assume that fallout shelters are provided universally (and uniformly) and that they are universally used for some minimum period like two weeks. It is evident that radical departures from these assumptions could seriously degenerate the effectiveness of civil defense.

A quantitative estimate of the life-saving potential of shelters must be derived from war-gaming studies of the sort described earlier. These studies differ pronouncedly among themselves in the underlying model, in the range of yields considered and most importantly in the nature of the attacks. Figures 19 and 20 show a sort of composite of what can be derived from these studies. Figure 19 is concerned with an antipopulation attack, and gives fatalities vs. total fission yield in megatons. The spread of the curves corresponds primarily to differences in details of the attacks, and to differences in the degree of discipline and training of the population. Special shelters are not assumed. The important point revealed by this graph is the very rapid accumulation of fatalities at very low levels of megatons delivered. This arises, of course, from the heavy concentrations of population in urban areas; however, its significance lies in the fact that relatively few delivered weapons with yields in the megaton range are adequate to cause millions of U.S. casualties, many of which are attributable to blast and fire effects. As megatons delivered increase, fatalities reach 160 million of the present 188 million citizens at about 3,000 MT of fission yield* -- or about double the current estimated Soviet capability.

Figure 20** gives the same information for attacks on military targets. Here the spread is enormous since a military attack might on the one hand confine itself to missile and bomber bases, or it might on the other hand include command centers, strategic ports and other key military installations. The top boundary of the graph indicates that such an attack would be indistinguishable with respect to fatalities from a purely population attack. It can be concluded from this chart that the intent of the attack can override its

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* Most studies assume, where such an assumption is required, that fission yield is fifty per cent of total yield.

** Figures 19, 20 and 21 are taken from the DOD Civil Defense Program Study (1961).

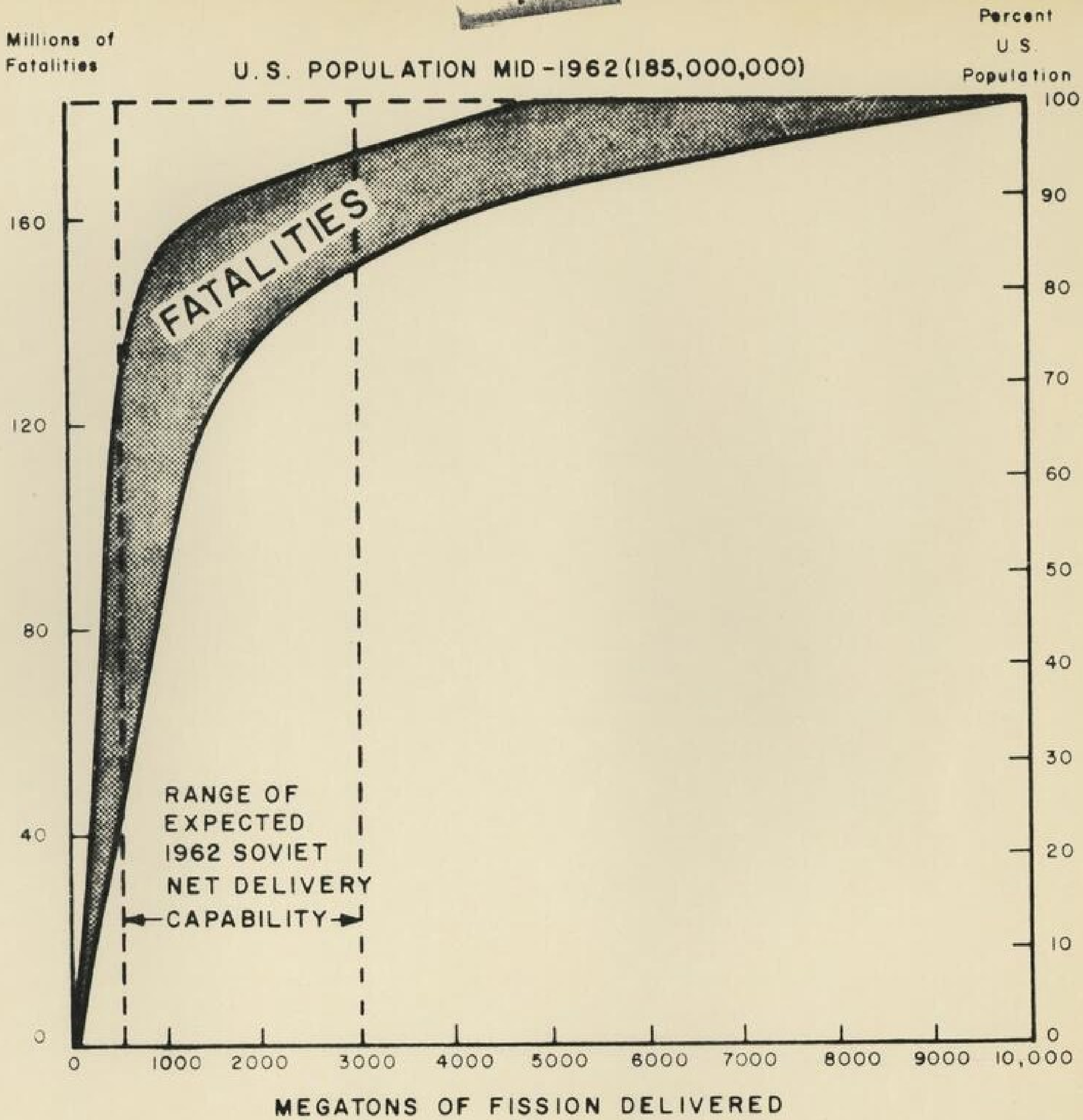

Figure 19. U.S. population fatalities from population attacks. The fatality range results from different casualty models and attack patterns that differ in detail.

3a

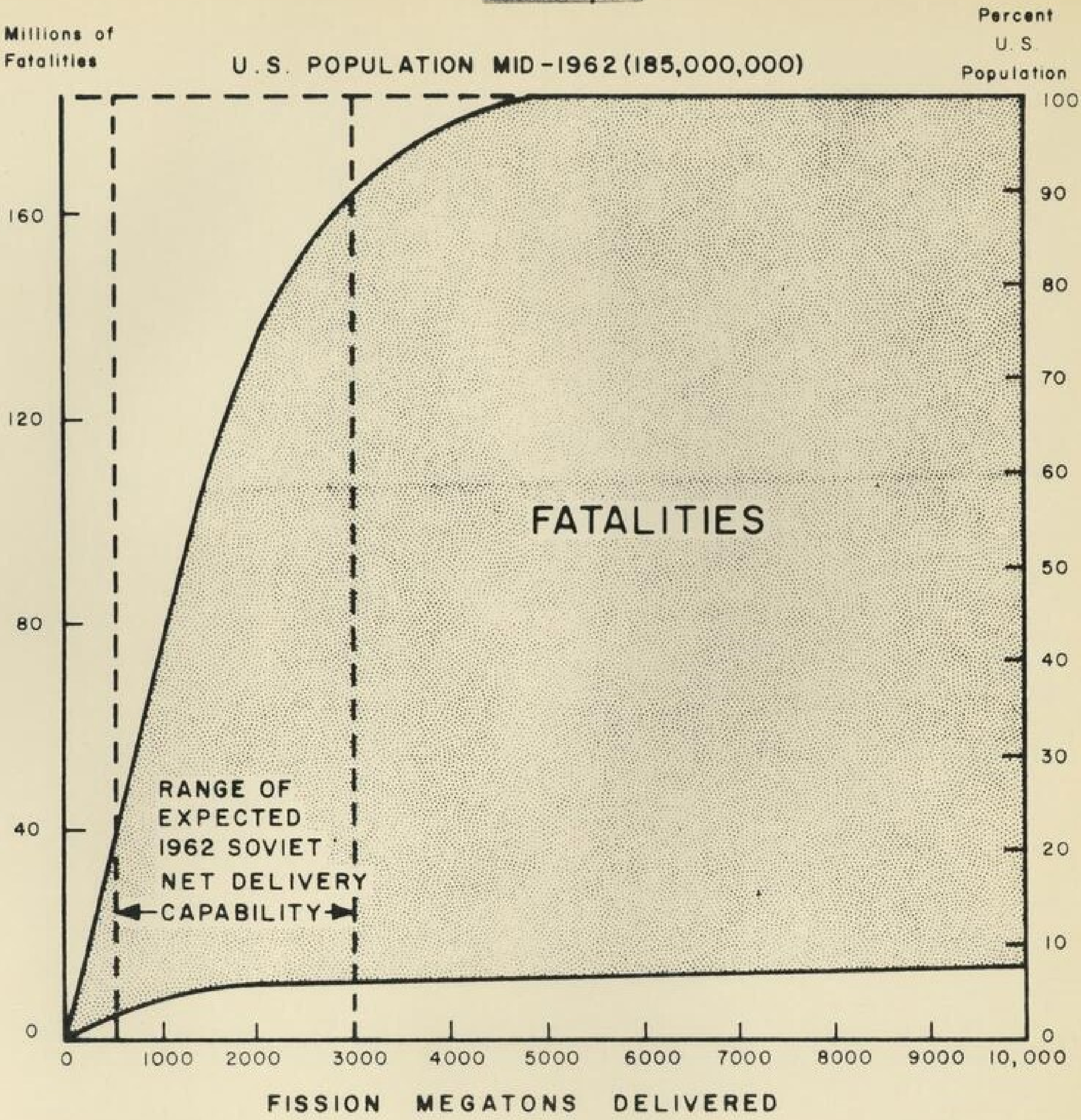

Figure 20. U.S. population fatalities from military attacks. (Fatality estimates cover the range between the two curves shown.)

weight in the determination of total casualties, since the lower and upper bounding curves differ principally with respect to the care exercised in avoiding civilian casualties.

The number of fatalities prevented by the use of fallout shelters also varies widely and depends on the weight and intent of the attack. In the case of antipopulation attacks of fixed weights, the number of lives saved appears to be reasonably constant, and for a wide range of attack weights is of the order of 15% to 25% of the sheltered population (as shown in Figure 12). For military and mixed military-antipopulation attacks, study results indicate that the intent of the attack is of such importance that both the fraction of the population saved and the total number of lives saved show wide variability even for attacks with a fixed number of total megatons delivered. The degree of variability is reduced, however, if attention is confined to the population at risk, e.g., to those persons who would become fatalities in the absence of any type of shelter.

For the spectrum of attacks with fixed levels of total megatons delivered on military targets, the population at risk varies widely, as shown in Figure 20. However, Figure 21 says that for the more moderate attack weights between 70 and 90 percent of those who would have died are saved by fallout shelters, assuming that they are universally available and fully used.

Finally, it is important to draw from these studies some indication of the role of various protection factors and blast resistance on the potential saving of lives. The results shown in Figure 22 are derived from the RISK I Study (mixed attack, 3,000 MT total yield). The ordinate scale is per cent casualties referred to the total population. There are two scales along the abscissa numerically identical. One refers to the Protection Factor (PF) provided in fallout shelters, the other to the blast resistance in psi of these shelters, assuming such a provision were incorporated. Beginning with the upper dashed curve, which refers to fallout shelters having negligible blast resistance, it is seen that at a PF of one (i.e., no attenuation), sixty-two percent of the population are casualties. For a PF of 100, this number has droped to 32 percent. It is to be observed that most of the improvement has been made by PF's of 50. (While this conclusion may be strongly dependent on attack distribution and on total attack weight, it indicates a rapidly decreasing value of high protection factors.) The lower curve refers to blast shelters--all of which are assumed to have PF's of at least 100. Casualties begin at the 32 percent point, and are reduced to about 6 percent when shelter resistance of 100 psi is reached. Again there is a sharp initial drop followed by a flattening off: the first 10 psi alone saves 11 percent of the population. While it is interesting to derive from the RISK I Study sidelights such as this on the possible utility of blast sheltering, there are many difficult technical, operational, and economic problems associated with their use that the Panel has not considered in any detail.

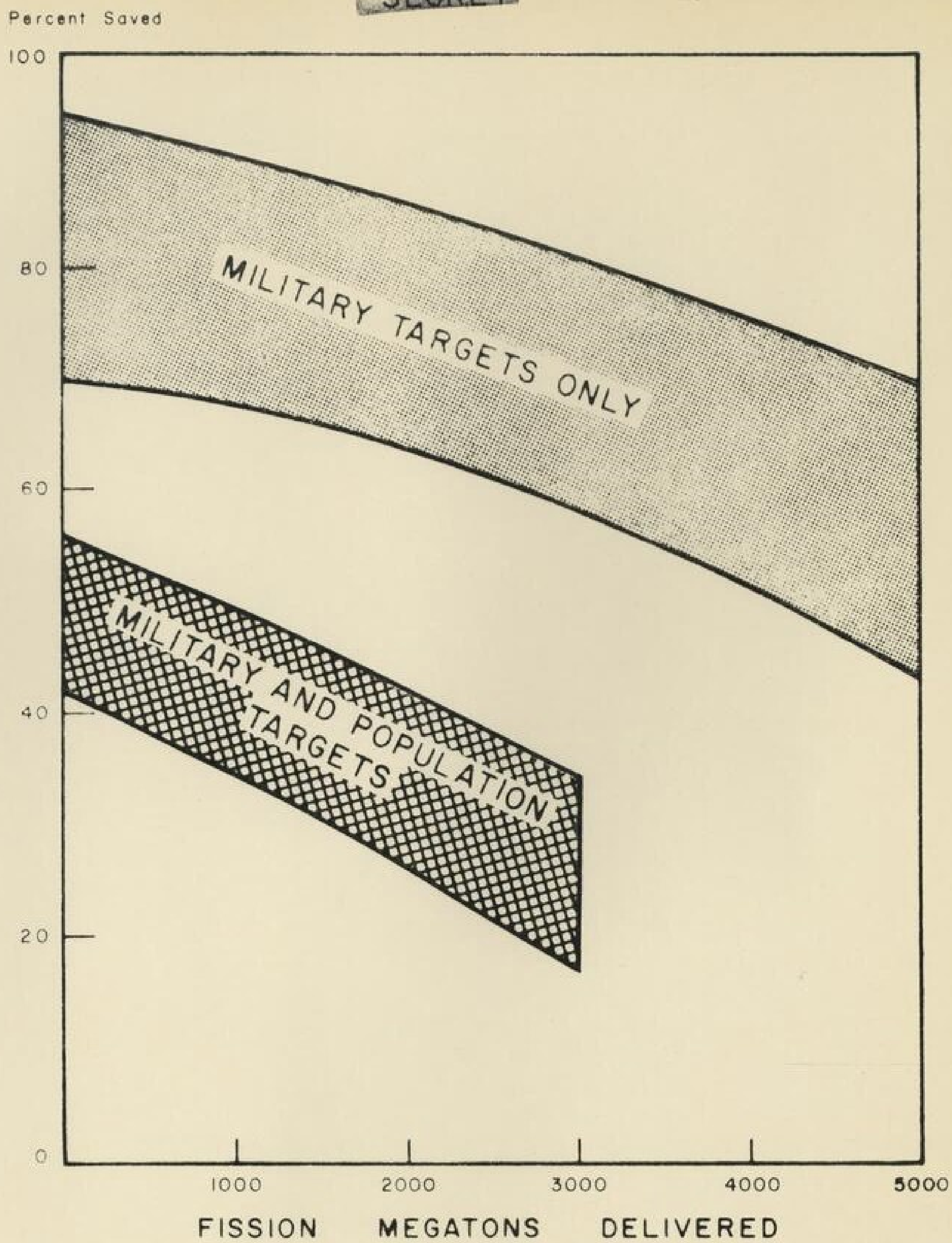

Figure 21. Percent of population at risk saved by full fallout shelter program. (Population at risk is defined as those persons who would die from all causes in the absence of any form of shelter.)

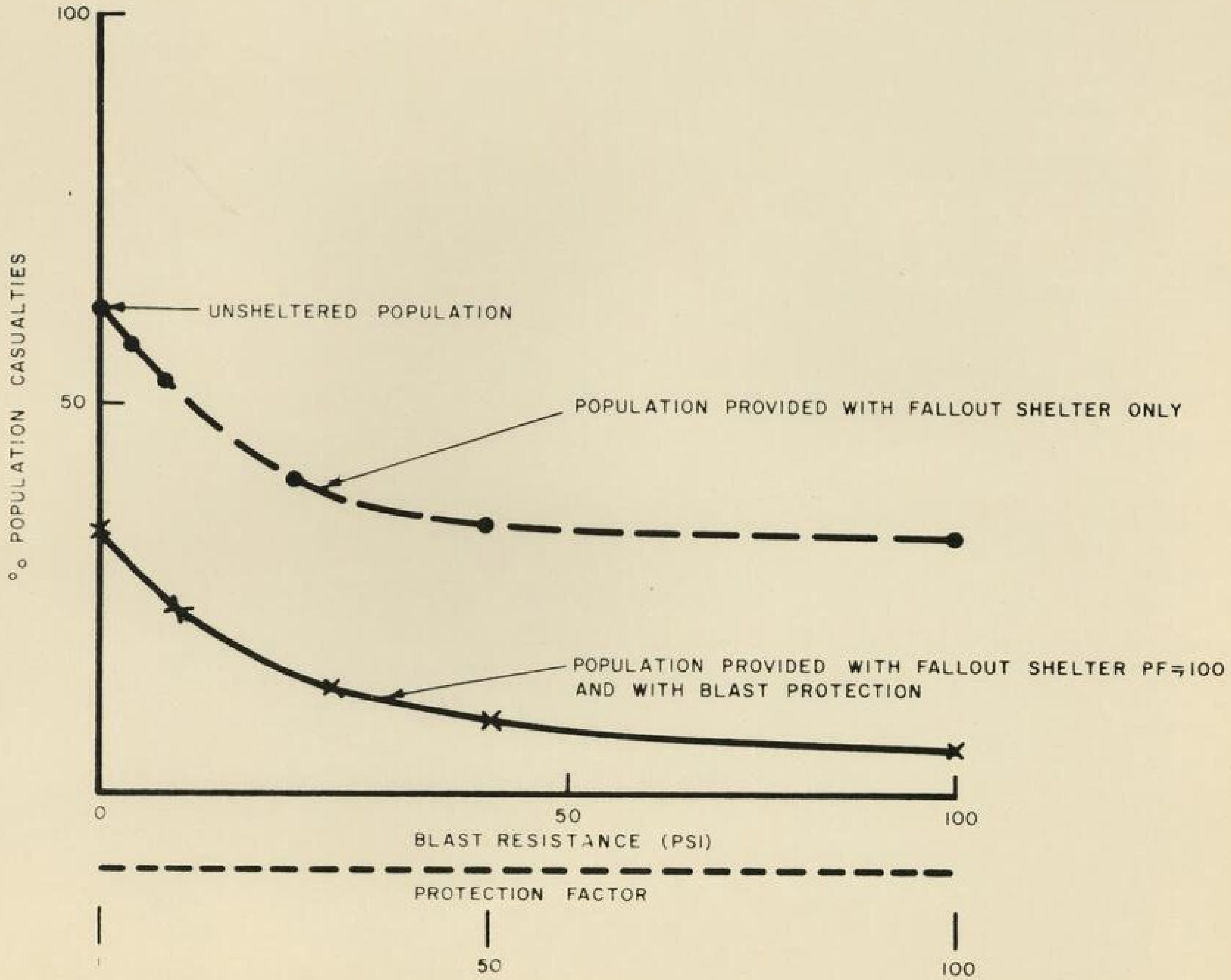

Figure 22. Variation of population casualties with protection in the RISK I attack of 3000 MT.

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D. Risks

There are risks of both internal and external origin associated with a formal civil defense program. The most important risks of external origin relate to possible Soviet responses and these are examined briefly in the following section. Later sections consider possible internal efforts of a civil defense program and the risks of technical obsolescence within the program.

1. External Risks: Possible Soviet Responses

One possible Soviet response to a U.S. shelter program might be no response at all. At current force levels, the only rational use the USSR could make of its strategic delivery vehicles would be a reprisal to a prior attack, and this reprisal could be expected to have a preponderant urban-industrial component. The USSR might reckon fallout shelters relatively ineffective against such an attack, and consider that no remedial action was necessary. Another possible reason for failure to respond might be a Soviet belief that we would be adequately deterred by the USSR's missile threat against Western Europe or by the mere prospect of great economic loss and disruption, threats quite unaffected by a U.S. national shelter program.

On the other hand, positive Soviet responses might be forthcoming. One form might involve changes in the size or character of the Soviet strategic force. In one form of such a response the USSR might merely add further units to its presently planned missile force until the balance (in terms of expected U.S. casualties) had been restored. In this particular form of response, it is assumed that the present Soviet ICBM force is fixed and relatively soft. The ratio of USSR effort required to redress the balance to the U.S. effort required to upset it (i.e., to set up the shelter program) is called the "exchange ratio." This concept is a useful one, although as noted in Part II, it is difficult to deal with it in any exact quantitative sense. However, this much can be said: for every missile the USSR has to deliver to restore the casualty level, they must deploy several such missiles, having to count on losing a number of these in the presumptive U.S. counterforce strike. This "magnification factor" tends to improve the exchange ratio associated with a shelter program. It would also, however, increase the likelihood of further escalation in the arms race, since the U.S. planners would have to regard the strategic balance as having been seriously threatened.

Either or both of these considerations might prompt the USSR to another form of response: namely, the incorporation into its missile force of features

such as camouflage, hardening or mobility. Given these, a greater proportion of its strategic force could be expected to survive the U. S. strike, and in this way the status quo ante in terms of casualties could be restored. There are, of course, many incentives to strive for these features in the course of a normal "product improvement" program, so the U. S. shelter program might at most hasten the advent of such changes. With a change of character without great increases in number, the effect on arms escalation might well be less than in the earlier case.

The Soviet responses might conceivably take a more passive form. For example, the USSR might respond with a vigorous civil defense program of its own. This reaction would make sense, on the basic assumption set down earlier concerning the strategic intentions of the U. S. and the USSR, if the USSR believed that a U. S. decision to strike would be seriously affected by the consideration of the expected number of Soviet casualties, or if the USSR also decided to pursue a more intensive civil defense insurance policy. It seems hard to argue for the likelihood of such a belief on their part. It is also difficult to see how a U. S. shelter program could affect one way or the other a Soviet decision to deploy an AICBM defense. However, the pursuance of civil defense as an insurance policy on the part of the USSR could probably be rationalized to the same extent as similar actions by the U. S.

Among all these various possible responses it is difficult generally to assign probabilities, and in most cases no attempt has been made to do so. But in addition to these rather specific and concrete things that might happen, there are other more general Soviet reactions that might result from a U.S. shelter program. For example, a suspicious Soviet Union might regard even a fallout shelter program as part of a U. S. bid for a first strike capability and become more intransigent in various areas of mutual concern. As another example, it has sometimes been suggested that even though a civil defense program could provide insurance against concealed weapons in late stages of a general disarmament agreement, the initiation of a strong U. S. civil defense program might constitute a serious impediment to arms control and disarmament agreements between the Soviet and the Western blocs. It is not a priori evident that this would be true though its possibility cannot be denied. It was indeed pointed out earlier that in the absence of arms control agreements the mounting of a massive civil defense effort might exert inflationary pressures on the strategic stockpiles of both sides. This, however, is not tantamount to saying that arms control negotiations or measures would be seriously jeopardized by the existence of civil defense efforts on one side or the other. The roles of both active and passive defense measures in relation to disarmament are extraordinarily subtle, and it appears that no simple general statements can be made.

In this connection it is worth noting that the usefulness of an established civil defense program in an arms control environment depends very much on the nature of the specific arms control agreement. If the arms control agreement prescribes reduction to zero or near zero levels of strategic forces, then civil defense could provide protection against a small clandestine strategic force developed in violation of the agreement. If, on the other hand, the arms limitation agreement involves a reduction of the strategic force to a higher level, then an extensive and effective civil defense program might upset the intent of such an arrangement by decreasing the deterrent value of the agreed strategic force levels.

In connection with all of these remarks it must be remembered that we are talking about risks and not about certainties. Such unfavorable attitudes as the above may not happen at all; it is essential not to forget the possibility that they may.

2. Internal Risks: Possible Effects on the U. S.

So far the risks discussed have been of an external nature, i.e., possible repercussions from Soviet reactions to the U. S. shelter program. There are also risks of a purely internal nature, i.e., repercussions of the program on U. S. society and government.

Among the various effects on U. S. civilian life, one concerns possible changes in the attitude of citizens toward nuclear war. It has been argued that a preoccupation on the part of the public with civil defense matters--and such a preoccupation is implicit in the OCD program--could result in alterations in the attitude of the public toward nuclear war. These attitudes could vary from increased apathy to various forms of desperation, active or passive, but could also include more constructive attitudes leading to increased diligence in searching for non-military solutions to potential conflicts. It is very difficult to predict in any quantitative sense how such attitudes would be distributed over the population. Aside from such possible reactions on the public from the existence of a civil defense program, there are parallel sorts of risks inherent in the non-existence of such a program. These might, for example, take the forms of deepening nervousness or anxiety on the part of the public, or a sense of being "abandoned" by their government.

A second possible effect on the U. S. public is difficult to define precisely, but is at least potentially worrisome. The proposed OCD shelter program (extrapolated to its natural goal of shelter space for everyone) might lead 20 or more percent of the adult U. S. population to be actively involved and to some degree responsible for a large national defense effort.

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This public involvement would represent a departure from the usual patterns of peacetime civilian activity in this country. While it cannot be asserted that the changed pattern is necessarily bad, it is very difficult to predict just how the fabric of our society would be affected by an abrupt and rather deep-going intrusion of defense activity into normal civilian life. One might imagine, for example, that a highly organized civil defense program of the sort contemplated might of necessity result in giving one segment of the citizenry coercive or quasi-police power with respect to the remainder, even under peacetime conditions.

There are further categories of risk of an internal and political nature. These are concerned with possible failures of program development owing to any of a number of causes: inadequate leadership, loss of bipartisan support, unbalanced and interrupted funding, failure to maintain continuing preparedness, and a fluctuating public response. In the latter connection, public interest and participation which may be essential to some types of programs, may be difficult to maintain without continual exhortation from the Federal level with the associated dangers of overemphasizing the immediacy of the threat or of claiming a degree of effectiveness for the civil defense program that goes beyond its real merits.

A source of possible danger which has been of concern to the Panel is the possibility inherent in such a program of public demands for progressively increasing protection. Once a fallout shelter program of the incentive type is well under way, it is conceivable that public pressures expressed through the Congress might result in demands for complete blast and fire sheltering, for example, irrespective of the technical feasibility, the economics or the social obtrusiveness of such an expanded program.

3. Technical Obsolescence

Civil defense is part of a continuously changing military posture part of which is not within the direct control of the United States. Civil defense measures, in common with most other defense measures, have a large built-in time delay from decision to extensive implementation. The delay may well be larger for civil defense than for many other more directly military systems since (a) the country is not yet accustomed to massive expenditures for civil defense, and (b) civil defense usually involves the consent or participation of a large number of groups that are to some extent politically autonomous. Hence, if the yields which can be delivered by the USSR against the U. S. keep increasing at a rapid rate, it may be very difficult to keep a civil defense program sufficiently modern to successfully cope with a threatened well-coordinated attack. However, as has happened in the past, the opponent may not build up at the rate his capacity

permits or his attack may not be a well coordinated first strike. Hence the "general insurance" motive for a civil defense program persists even in the face of the obsolescence problem.

E. Summary

It has not been the aim of this Part to draw conclusions but rather to raise the questions that must confront any civil defense program. In doing so it has become evident that civil defense can aim to alleviate in varying degrees a wide spectrum of damage patterns with particular emphasis on saving lives. However, the development of such a capability is limited by the nature and scale of the attack, on one hand, and the cost and risks involved in preparations on the other. Thus no complete solution exists to the civil defense problem. Instead there is a balance to be chosen. On the one side, there is a series of options which provide increasing, but far from complete protection. Some of these have utility for all foreseeable kinds of attack; others are more specialized and, therefore, may not be effective for one particular kind of attack. On the other side, there are the mounting costs of this series of options. The costs increase not only in budget dollars but in personal and social values and at high levels may threaten the imposition of a war-time regimentation on our citizens and a provocative character to our military posture.

In striking this balance, it would appear that there is a large technical component in assessing the effectiveness of any given civil defense program although this cannot be set apart from the efficiency with which the program is administered. The costs of different levels of civil defense, or of different alternates within a given level, are analyzable in financial terms but the effects produced in other ways often seem more important. At low levels of civil defense effort measures of wide utility can be recognized and implemented without the costs or intrusion into the society being seriously questioned. The survey and marking of shelter space would appear to fall into this category. At higher levels of civil defense effort each further increase in effectiveness tends to exact a higher generalized cost or risk. Moreover, the long term value of each such step must be questioned in order to prevent obsolescence. The role assigned to the citizenry should be carefully justified since the means of maintaining indefinitely a state of preparedness throughout the population may be neither available nor desirable. Finally, the magnitude of the civil defense effort is likely to make itself felt in the international arena in either a rational or irrational way. These many considerations which enter into the choice of proper balance in civil defense are extremely complicated and interact in many ways. Our aim has been to examine and illuminate these as best we can. But one can readily foresse that the technical considerations, while of the

highest relevance, merely define broad limits in which the political choices must be made.

In this context the fallout shelter program, the major part of the present OCD effort, has been examined; this is reported in the next Part (Part V). Following this a similar critical review is made of the planning and requirements for the post-attack situation (Part VI).

V. THE SHELTER PROGRAM

A. The Program

The essential details of the OCD shelter program were outlined in Part II. It is designed to produce fallout shelters for the entire population by 1968. Roughly one-third of the total of about 235 million shelter spaces will be obtained by locating, marking and stocking shelters in existing buildings. Another third will come from new construction or building modifications via the Shelter Incentives Program. A final, somewhat smaller third will hopefully come from private construction. Very roughly, the total shelter program will cost from \$6 to \$10 billion. This will come approximately 60 per cent from Federal funds and 40 per cent from local government funds and private sources.

The present program emphasizes dual-purpose community shelters; it has de-emphasized the role of family shelters. The arguments in favor of community shelters are twofold. One is that, from the standpoint of gross national cost, they are cheaper. The expectation is that community fallout shelters will cost an average of about \$40 per shelter space; family shelters with comparable protection and facilities would cost several times more. The more important argument in favor is that the survival value of community shelters is considered to be much higher. Shelters which contain from 50 to 1000 people permit a trained organization, with adequate supplies and instrumentation and with carefully laid out plans and procedures. The existence of a shelter management organization should aid both the shelter life and the post-shelter recovery.

The chief reason for proposing that shelters be dual-purpose is that the cost will be less if they are part of another function, e.g., a school cafeteria. Another reason is that the shelter space will be better maintained if dual-purpose. In a typical city the area where people work is usually far distant from the residential areas, hence there must be some excess of shelter spaces to take care of both daytime and nightime contingencies. It is, of course, both natural and desirable to use large city office buildings as dual-purpose daytime shelters, however, the problem of storage space for supplies may severely limit their availability.

Individual family shelters are often the only available solution for the people who live in rural areas. The OCD has developed detailed construction plans for family fallout shelters and encourages dissemination of these by local groups but it does not expect to give any financial aid to construction of family shelters. This may be a reaction from the recent public outcry against

individual shelters. However, it is probably somewhat unfair to the rural family not to give them some financial aid. This is particularly true for the farmer who, in addition to his own family, must give consideration to fallout protection for his livestock. In view of the early stage in the overall program, the problem of rural and agricultural shelters has probably not yet been thought through.

B. The Shelter Surveying, Marking and Stocking Program

The program on which by far the most progress has been made is that for surveying, marking and stocking of community fallout shelters in existing buildings. Shelter standards have been firmly established. All marked shelters must have space for at least fifty people, adequate ventilation, with a protection factor of at least 100. Shelters must be open to the general public and control of the shelter (during its use as a shelter) must be released to local civil defense authorities. Building owners must make available storage space for the shelter supplies to the extent of one cubic foot per shelter space. This last requirement may be troublesome since in a crowded well-operated office building, the required storage space may be hard to come by. A noteworthy feature of this program is that the full monetary cost is borne by the Federal Government; the building owner makes a real donation of the needed storage space but this does not show up in a direct money obligation.

Surveying of the shelter potential of existing buildings is virtually complete. The collected data are now being machine processed and the results are rapidly being returned to local civil defense organizations. Once these groups have sought and obtained permission from the owners of those buildings which have suitable shelter areas, the chosen shelters can be marked, stocked and equipped with standard signposts. In this way, OCD expected to bring into being about 50 million shelter spaces by early fall of 1962. Most of the shelters will be in downtown city areas, and hence particularly suitable for the daytime working population, but moderate amounts will be in outlying schools, hospitals and other large buildings. OCD assumes that during the next five years another 20 million shelter spaces will become available under this program. Some will come from projected new buildings; others will come from modest modification of existing buildings, for example, by improvement of basement ventilation or by thickening of roofs.

The OCD has recently undertaken a pilot marking and stocking program involving 14 cities whose results cast some light on the problems to be encountered in the licensing and stocking phases of this program. A total of 169 buildings containing 118,000 shelter spaces were selected for licensing,

marking and stocking. Of these, a total of 120 buildings with a revised capacity of 74,000 spaces (67%) have been licensed. Action on 10 buildings was pending as of May 25, 1962. The remainder -- 39 buildings with 33,000 shelter spaces (29% of the revised total) -- were dropped from the program. The reasons for failure to secure these latter spaces as shelters were as follows:

Reasons	No. of Buildings
1. No storage space for supplies	6
2. Owner refused to participate	6
3. Space to be utilized as private shelter	5
4. Protection factor less than 100	4
5. Previous mobilization commitment	4
6. Below habitability standards	5
7. Miscellaneous	9
Total	39

Clearly, the problems encountered were numerous, perhaps to a greater extent than anticipated.

The shelters and buildings actually licensed consisted primarily of basements (about 95%), i.e., only very limited aboveground space was licensed for use as shelters. This result is somewhat at variance with the frequent image of stocked shelters in well ventilated offices on the central floors of large buildings. As a final observation, the quantity of eligible spaces not secured for the program casts doubt on the estimation of the number of spaces (70 million) currently expected to be obtained by the overall survey program.

None of the shelter marking plans gives any consideration to blast and fire protection even though most of the shelters which are generated by this program will be in large cities and hence in probable target areas for some types of attack. Actually many of the fallout shelters which are being marked will offer some blast and fire protection as a bonus. Many others would offer

considerable blast and fire protection with only such modest modifications as addition of blast doors.

One of the most significant aspects of this shelter stocking and marking program is that it will generate a very substantial number of shelters in the coming several months. This large number will serve several useful purposes in addition to the obvious one of providing an initial group of shelters. The existence of these shelters will give the local civil defense organizations a solid problem to work with and a substantial reason for serious emphasis on their training and organization problems. In addition the first hand consideration of shelter supplies and the assessment of problems of communication and radiation monitoring will without any doubt be of great benefit in the planning of the further fallout shelters which are expected to come along later. To reintroduce the technology analogy which was discussed earlier, this group of shelters will provide an immediate and very large-scale pilot plant for further study of the overall problem.

In the Panel's judgment this fallout shelter marking and stocking program has been carried out most expeditiously by OCD. The group concerned has shown both vigor and imagination and deserves commendation.

C. Standards for Shelter Stocking

The standards for stocking of fallout shelters are the same for both the marking and construction programs. All supplies are designed for a shelter-life of five years. The recommended level of stocking can best be described as austere with occasional inadequacies.

Food

Every shelter is to be supplied with enough pressed wheat biscuits to give 10,000 calories for each shelter space. This will mean 700 calories per person per day for the planned stay-in of 14 days. This is not a large caloric intake but it should be adequate for an otherwise healthy population.

Water

Each shelter space will be provided with enough water to give one quart per person per day for the 14-day period. This may be barely adequate for a healthy shelter population during a cool time of year. It is grossly inadequate for a shelter population with a significant fraction of sick and wounded,

especially during a period of high temperatures.* (By contrast the OCDM recommended water supply was one gallon per day.) This lack of distinction between the problems of shelters in remote areas and those in probable target areas is one of the more serious defects in the present shelter program. This will be considered in more detail later.

Medical Supplies

The character of the medical supplies which are to be stocked varies with the size of the shelter. For the smaller shelters (spaces for from 50 to 100 people) the supplies are almost exclusively of the first aid type. There is some doubt whether the recommended supplies are well chosen even for this role. For example, there are no analgesics (pain killer), no thermometers, no antibiotics and no sleeping pills or tranquilizers but there is a sizeable supply of aluminum hydroxide gel tablets. For the larger shelters the medical supplies cover a wider range and appear to be more adequate.

Sanitation

Provisions for sanitation are austere, even primitive, but probably adequate for a healthy population. A fiber drum with an attachable seat is the toilet and a 5 x 8 ft. plastic screen is available to be strung up for privacy. Emptied water containers are to be used as replacements for the first fiber drum as it becomes filled. It is distinctly uncertain whether these supplies will be adequate for a sick and wounded population. No sanitation equipment for bedridden people is available in any of the medical kits.

Radiation Monitoring

All fallout shelters are to be equipped with radiation monitoring devices. The monitoring kit contains both survey meters and dosimeters as well as calibration devices. It is also planned that many of the peacetime, federally-sponsored radiation monitoring stations will be located in or contiguous to shelters. The instruments for the fallout shelters are well designed and should be satisfactory for their functions if they are properly maintained during the peacetime storage period.

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* Just as the final draft of this Report was being prepared, information was released on a U.S. Navy experimental test of the reactions of healthy volunteer adults to shelter living. The results indicate that the difficulties of shelter living may be far more serious than so far realized, especially when water supply is extremely limited. The Panel has not had the opportunity to review the results of this experiment in detail.

Communication

No provision is being made for Federal stocking of any communications equipment in fallout shelters. It is assumed that some of the shelter occupants will bring along their battery operated AM radios and that these will be adequate for receiving Conelrad radio messages. Even though these assumptions are reasonable ones, particularly if local organizations delegate people to bring radios, it is rather doubtful whether so important an item as communication should partially be left to chance. It would also be most desirable to have two-way radio communication between shelters and central civil defense headquarters. At least the larger shelters might well be supplied with the necessary equipment. OCD recommends this to local organizations but there are no plans for Federal support of such systems.

Ventilation

Since many of the marked shelters will be in basements of large buildings, the problem of ventilation is an important one. Under current plans, OCD requires 500 cubic feet of space per person if ventilation is below a prescribed minimum, but only 10 square feet per person when ventilation (forced or natural) meets standards. In computing whether forced ventilation (such as would be needed in basements) is adequate OCD permits local groups to assume that public power will be available to run the system. Since most of these marked shelters will be in urban areas, i. e., in probable target regions for an attack on populations, the Panel regards this assumption as unrealistic and liable to lead to dangerous consequences.

Returning to the problem of the basic supplies which are scheduled for the fallout shelters, the Panel wishes to call attention to the fact that a very strong case can be made for varying the character and quantity of the supplies depending upon the probabilities that the particular shelter will be in a target area. As noted in the discussion of Figure 9 (Part II), many areas of high fallout will have also suffered blast damage with the consequence of many casualties. The direction to take, of course, would be greatly to increase the medical supplies, provisions for sanitation and, most especially, the water supply for fallout shelters which are at all likely to face the problem of taking care of sick and wounded which may result from the direct blast and fire effects of nuclear weapons. Without departing too sharply from the present proposal that the program be only one for fallout shelters, it still should be possible to base this variation on a simple distinction between shelter stocks for major urban areas and shelter stocks for other areas.

D. The Shelter Incentives Construction Program

OCD plans call for Federally aided construction of enough dual-purpose community shelters to give an additional 100 million shelter spaces by 1968. The Shelter Incentives Program is designed to bring this about. Federal incentives money may be available, up to a maximum of $25 per shelter space, i.e., $2.5 per square foot at the planned level of 10 square feet of floor space per occupant. Eligibility for the incentives program is restricted to those which will produce shelters that conform to the OCD standards. These standards are the same as for the Shelter Marking Program, e.g., a minimum capacity of 50 persons, 10 square feet minimum per person, adequate lighting, ventilation and habitability. Furthermore, to be sure that the shelter will be useful, its location must be approved by the local civil defense organization. The hope is that dual-purpose shelter construction will be included in new schools and hospitals since, in the jargon, "schools are closely colocated with population." Schools and hospitals offer the further advantage that they contain trained and educated people who would be available for peacetime shelter maintenance and for wartime shelter management.

OCD estimates that the average added cost of dual-purpose fallout shelters will be about $40 per space. If this is correct, construction of the new spaces will be shared roughly 60 - 40 between Federal and local governments. OCD also believes that with good design, the Federal aid of $25 per space will often cover the entire added costs. However, the problem of cost sharing for these dual-purpose shelter spaces has already shown itself to be serious. Many local school boards have refused to participate in the program; local users have argued strongly against it; prominent educators have deplored the complications which result from the dual-purpose aspects of such shelters. As of the present writing, it is far from certain that this program will gain general community acceptance.

OCD has recently made public announcement of the first fallout shelters being built in new Federal construction. These are to be in several varieties of buildings under the control of the Forest Service in northwestern Montana. The cost of these dual-purpose fallout shelters, the size of which varies from 50 to 450 spaces, is stated to be $171 per shelter space. Even though, as noted in the public release, costs of initial shelters may be abnormally high, this very high figure casts some substantial doubt on the OCD estimate of an average cost of $40 per space.

It is in the context of new shelter construction that the problem of inclusion of blast and fire protection becomes most significant. By modest changes in

design it is often possible to include substantial protection against both blast and fire at only slight added cost. The question then is, should not this protection be included, particularly for new construction in regions near to probable targets? So far, OCD has made no provision for this and has maintained its position that only fallout shelters are to be supported.

E. Shelters from Private Construction

The OCD program contemplates that the Federally-sponsored and supported program of public community shelters will be augmented by three sorts of privately constructed shelters. The least significant of these is presumed to be family shelters which are constructed by urban and suburban residents in their basements or back yards. Although OCD has issued approved designs for such private family shelters, not much enthusiasm has been generated for this sort of shelter and OCD does not expect to encourage their construction. The assumption is that such shelters will make only a modest contribution to the total plan.

Individual shelters are the only reasonable solution for the fallout protection of the truly rural families. As a rough estimate, 20 million people dwell in areas such that community shelters are not feasible. Fortunately, fallout is the only serious danger to the great majority of these families so that the OCD designs for family fallout shelters are entirely relevant. The real question is whether the requisite number of shelters will be built without any incentive or financial aid plan. As noted earlier, the Department of Agriculture is responsible for informing and assisting the rural families in their civil defense needs but in view of the small available funds, $60, 000 requested for FY 1963, it is questionable whether the rural group will get adequate attention. So far there has been little evidence that the planned-for shelters will actually be built.

The third variety of shelters which the OCD expects to be built with private funds is the privately constructed group fallout shelter for selected groups of people. A conceivable example is a non-public basement shelter for the occupancy of a newly constructed apartment house. A much more plausible example is a shelter, quite possibly a dual-purpose shelter, for the workers of an industrial plant. Since most workers in these plants will also need shelter space in shelters which are close to their homes, these industrial shelters are complementary to a community shelter program. OCD expects that about 40 million such shelter spaces will be built in the next 5 years. OCD will give advice about shelter construction and clothing for these shelters but will not contribute any direct Federal aid unless the shelter is available to the general public.

It is difficult to assess the probability that the expected numbers of private group shelters will actually be built. However, several industrial plants have already constructed shelters and if the community shelter program goes vigorously ahead, industrial shelters may attain the status of an expected or required fringe benefit. If so, the real and serious problem in the private shelter area will be those for rural dwellers. In view of the importance of farms and farmers to any long range recovery plans, the Panel believes that this area deserves further intensive study, with the expectation that Federal assistance to this group may ultimately be required.

One feature which somewhat eases the problem of rural shelters is that on the average a farm will be many miles from probable targets so that there will be several hours from the time of the attack until arrival of substantial fallout. This means that a typical farmer will have a few hours in which to make last minute preparations both for his family and for his livestock. If this period is to be effective, however, it is essential that the farmer have detailed plans for livestock protection, for emergency water for stock and probably also for a quickly arranged fallout shelter for his family (assuming that he does not have a permanent planned and stocked fallout shelter). Undoubtedly this type of arrangement will need to be worked out between the farmer and his county agent or some similar person. In addition to plans, a key item for this type of operation will be availability of instruments for monitoring the radiation. Without these the farmer will simply have no way of knowing when he must abandon such emergency preparations.

F. Pre-Attack Shelter Organization

A complete nationwide fallout shelter program will necessarily involve a cadre of trained personnel to maintain the shelters during peacetime and to be ready to manage them during war. As envisaged by OCD, this cadre will be large and consist primarily of volunteers, recruited and trained by local civil defense organizations. The needed number of volunteers is so large as to involve a substantial fraction of adult Americans. To illustrate the needs, the latest draft of the OCD Guide for Shelter Management indicates that a fallout shelter for from 50 to 100 people will need about 25 people to operate it, presumably at maximum efficiency. Of these, about 10 or 12 need prior training. The needs for trained people are specifically:

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Position	No.	To be Trained
Shelter Director	1	1 - 2
Deputy for Information	1	1
Deputy for Operation	1	1
Chief, Feeding Team	1	1
Chief, Health and Sanitation	1	1
Chief, Safety	1	1
Chief, CBR and Communications	1	1
Deputy, Supply and Maintenance	1	1
Radiological Monitors	2	2
Communications Manager	1	1
Total	11	11 - 12

For larger shelters the needed numbers of trained people increase but not proportionately. As a rough guide, about 10 per cent of the sheltered population should have prior training, i.e., roughly 20 million people or about 1 of every 4 adults. The program can certainly operate with fewer than this but as a reasonable minimum for the currently programmed type of operation, 10 million trained people will be needed. Note that the above list does not consider medical officers for shelters; responsibility for training these is in the hands of the Department of Health, Education and Welfare.

To obtain and maintain the required shelter management organization will place severe demands on the local civil defense organizations. The chief problem areas are: (1) recruitment of personnel; (2) training of personnel; and (3) maintenance of preparedness.

The most obvious place for a local civil defense organization to turn when it starts recruiting personnel for shelter management is to the trained and available people within its local government organization, such people as teachers, policemen and firemen. There are, of course, very good reasons for doing this even though some concern can be raised about giving these people added duties in view of the already overburdened nature of educational programs, and of most fire and police departments and the increased demand on them in the case of nuclear bombardment. However, even if these people are extensively utilized, their numbers are not anything like enough to cover the needs of the kind of organization discussed in previous paragraphs. This means that the civil defense organizations must turn to volunteer workers. (There is one other sizeable group of trained personnel in the average community to which

3a

serious responsibility has so far apparently not been given; this is the group of National Guard and active Reservists of the Army, the Navy and the Air Force. The question of utilizing this group will be referred to in more detail later in this Report.) Recruitment of even modest numbers of willing and competent volunteer people, capable of making a prolonged contribution, is always troublesome except in times of crisis. To recruit competent people to the extent of perhaps 15 per cent of the adult population is a staggering task. The Panel has serious doubts whether this recruitment can be accomplished without running into real danger of "overselling" the civil defense program. The Panel strongly suspects that this problem will become apparent when shelter organizations are developed for the modest number of shelters which will be provided by the shelter stocking and marking program. A likely consequence is that the number of trained people recommended for each shelter will be decreased and that there will be further attempts to utilize people who can either be paid or be expected to contribute in view of their full-time jobs.

The actual training of shelter managers is a responsibility of the local civil defense groups but OCD will supply course outlines and training aids and will set up schools to train the necessary teachers. Even a once-only training program will require a large effort but the need for refresher courses and for training of replacements for "dropouts" will make training a substantial continuing effort.

A key problem is maintenance of preparedness. This has many facets. It involves continuous training of shelter management personnel, maintenance of equipment, inspection and maintenance of supplies and rehearsal both of the shelter management group and of the civilian shelter users. Shelters will only be fully utilized if each family in a community knows what shelter it is to use, what routes it should follow to get there, what supplies to bring and is confident that the shelter will be open, stocked and well-managed. This strongly suggests that for maximum utilization the shelter users should themselves undergo some training and, particularly, frequent rehearsal. However, the implications of such rehearsal, both from the standpoint of magnitude of task and of the sociological aspects, are such as to make it rather doubtful whether this can actually be done. It is much more feasible, although itself difficult, to maintain the shelter management in a state of continuous preparedness with, again, the implications of training, rehearsal and maintenance. It is quite probable that this point more than any other will tend to push local civil defense organizations in the direction of utilizing paid personnel for shelter management or at least personnel who must serve as part of an over-all assignment in the community.

In the judgment of the Panel these problems of shelter management, of rehearsal, and of maintenance of supplies are serious ones. We strongly suspect that this will become evident as local defense organizations become actively involved in developing their individual shelter plans.

This brings into focus critical policy problems of shelter management, public rehearsal, and the maintenance of shelter supplies. If volunteers cannot be secured, how should the shelters be manned? If public rehearsals are not feasible, what degradation in the effectiveness of shelter utilization does this impose, and how should this affect future programs? If shelter stocks cannot be maintained by volunteers, what type of organization is needed? These will be given further consideration in Part IX.

G. Shelter Utilization During and After an Attack

There is a wide spectrum of situations under which thermonuclear attack might come to the U. S. It is conceivable that it would be preceded by a lengthy period of great tension. If this were so, there might be very large scale evacuation of cities to the point where the rural areas would be so greatly overcrowded that even if their shelters were improved and made adequate for normal conditions they would be grossly inadequate to handle the influx. Simultaneously, the urban areas would be drained of population to the point where their shelters would be only moderately utilized. It is also conceivable that the attack will come suddenly but that the initial strike will be on missile sites in the classic counterforce manner. In this case it is again possible that there will be panic evacuation of urban areas with the resultant problems of traffic jams, displaced people, etc. A third possibility which actually seems rather less likely, is that the attack will be more or less instantaneous over the whole country. Only in this case will there be much chance for maximum shelter utilization. Even here maximum utilization is doubtful simply because of the serious problems of availability of shelters and of strong tendencies of families to attempt to become united in a time of crisis. But assuming this type of attack, the problems which will be encountered in shelters will be very different for different areas.

In the areas which are remote from the targets the utilization of fallout shelters can be reasonably efficient. Since the fallout will take some time to come down, there will be ample period for warning and in most cases for the reuniting of families. People will be able to come to their preprogrammed shelters with planned supplies and with reasonable understanding of the condition of their region and of their country. In this circumstance, with a healthy shelter population, the problems of shelter management should not be at all difficult. Supplies for the shelters should be reasonably adequate as programmed and radiation monitoring and communication should be entirely feasible.

The situation can be quite otherwise for those shelters which are sufficiently close to ground zero of the enemy's nuclear weapons as to be in regions subject to blast and fire damage. In these areas only a short time will be available before radiation reaches high levels. Much more importantly, the regions will be ones of enormous damage, of fires, of blocked streets and of trapped and wounded people. To the extent that shelters are utilized they will be utilized by people suffering from shock, by people who straggle in at different times, often bringing wounded along, frequently arriving so late as to be suffering from severe radiation sickness. In these circumstances the fallout shelter may serve more as a field hospital than as a conventional fallout shelter. Put another way, in regions of high damage the problems of the immediate post-attack situation may be far more serious than those of immediate fallout shelter. This will be increasingly true as attack levels mount and when attacks are specifically directed toward population centers.

For fallout shelters in these areas of high damage the management situation will be particularly severe. The immediate drain on the medical supplies and on water supplies may be enormous and this will face the shelter management with serious decisions. At the same time the problem of actual management of a shelter group, with many wounded and sick, will be decidedly difficult and problems of maintenance of morale or avoidance of panic may be serious. It will be particularly important in these areas that the management be efficient and well-trained, that adequate medical care be available and that there be good communications between the shelters and the outside defense organization. It is because of the character of these added problems for probable target areas that the Panel believes that as a minimum the supplies for shelters in urban areas should be considerably amplified over those for shelters in more rural areas.

One of the major functions of the shelter management will be to decide when the shelter group can emerge from their shelters and attack the problems of local and national recovery. This will depend considerably upon the efficacy of the radiation monitoring and communications. It will also depend on the adequacy of the shelter supplies. In regions of relatively low radiation, particularly if they are also regions of low damage, this problem should not be at all serious. It may be substantially more difficult in areas of very high radiation. For many groups it may turn out to be desirable that they not attempt to revive their particular city but rather to move to some other area. The importance of this sort of decision emphasizes the necessity for an effective overall command and control during the post-attack period.

3a

H. Warning and Alert

For maximal effectiveness of any shelter program there must be provision for enough warning to alert all the people to a coming attack. For shelter from fallout only, the warning need not be exceedingly rapid since there is a substantial delay between the actual nuclear explosion and the first appearance of fallout. This point is discussed in much more detail in Part II. It is possible that even the present warning system as discussed in Part III and which has both Federal and state and local components, would be adequate for the problem of fallout shelters in areas distant from likely targets. If the NEAR system is installed, properly maintained, and operated with the efficiency which OCD now contemplates the warning for the fallout shelter program should be reasonably adequate.

The problem of adequate warning for a blast and fire shelter program is substantially more difficult. For this case, the warning must precede the attack. It is doubtful whether even the planned warning systems will be adequate for this. The BMEWS Distant Early Warning System can give no more than 15 minutes advance notice of a missile attack and it is quite uncertain whether this short advance notice will give adequate time for decision-making and dissemination of general warning signal to the public. The situation for attacks by bombers is, however, much less difficult. Here the distant early warning signal can easily precede the attack by some hours and there should be sufficient time to permit people to occupy any available blast or fire shelters. Moreover, the possibility of substantial strategic warning exists and in such cases some civil defense measures can be initiated days or even weeks in advance of an attack.

3a

VI. THE POST-ATTACK PERIOD

In the event of nuclear attack, the saving of lives takes priority over any other national goal except the effective operation of the Armed Forces, which ultimately serves the same purpose but with different means. This priority is accorded the very highest position because the "right to life" is the center of our system of values. But it is well to recognize that this priority also coincides with the coldly rational requirements for the survival and recovery of our society. Although the possibilities for doing this will also be affected by the surviving material components of our civilization, they will be primarily limited by manpower and the effectiveness with which it can be deployed against a myriad of unpredictable circumstances. It is, therefore, important to appreciate that the instinctive assignment of highest priority to saving lives finds only support and reinforcement from the technical requirements for the recovery and recuperation of the Nation.

The overall effort focussed on saving lives falls naturally into three areas: (1) prior provision for protection against weapons effects; (2) immediate post-attack operations aimed primarily at rescue and care of casualties; and (3) long range post-attack operations aimed at restoring the essential conditions of life for the survivors as a base upon which the rebuilding of the Nation may begin. The first of these three areas has been treated in the previous Part. Here we will deal with the other two areas.

A. Immediate Post-Attack Problems in Disaster Areas

Our examination of the immediate post-attack period has led to an increased concern with the plans for dealing with disaster areas. In non-disaster areas civilian activity will be dominated by shelter operation and confinement in fallout shelters and the organization of aid in those areas with relatively little fallout. In disaster areas there will be enormous needs requiring prompt action: rescue, medical care, damage assessment, restoration of essential services. These are discussed in turn and in a final part the problem of providing a standby capability for meeting these demands is examined.

1. Rescue Operations

The people of concern for rescue operations are those injured and trapped persons at the periphery of areas of intense destruction. The attack studies indicate that these are likely to number tens of millions. Indeed in some attacks the number of these persons is comparable to those whose lives would be saved by a comprehensive fallout shelter program effectively used.

Moreover, with the attack levels and accuracy expected over the next decade, this group of injured and trapped are perhaps a more certain consequence of nuclear attack on cities than fallout victims since the option to use air bursts in population centers may greatly diminish potential fallout casualties.

The attack studies so far made, although decidedly lacking in detail and specificity, still show that large numbers of these injured and trapped people can be saved. For example, the Birmingham and St. Louis Studies together with the fallout pattern expected in the event of a steady wind of 10 - 20 mph show that entrance to a large sector of the attack area can be made even though the downwind area would be inaccessible. Moreover, the great reduction in intensity of fallout radiation in the first few hours after attack would open up substantial additional areas for rapid rescue if the population had had even elementary fallout protection. This can be illustrated by a consideration of the inference of time on the effects of a nuclear bomb, specifically by considering the later history of the 20 MT surface burst, which was first described in Part II and in Figure 8. Figures 23 and 24 show the effects of this weapon at respective times of 7 hours and 24 hours after the burst. The circles illustrating areas subject to blast and fire effects are, of course, the same as those of Figure 8. The areas which are subject to excessive radiation dose levels are, however, much smaller than at early times. Figure 23 indicates that large portions of the regions for which blast and fire damage is probable, e.g., areas with overpressures in the range of from 1 to 10 psi, are subject to relatively low fallout. (In particular, close-in areas for which the dose rate is as high as 30 r/hr can be penetrated by rescue teams for periods of some hours.) As Figure 24 illustrates, the areas accessible to rescue, fire control and restoration of services are still much larger 24 hours after the explosion.

A somewhat more quantitative estimate of the times available for rescue work can be obtained from the data of Table 6 which permits a determination of the total dose to be expected from early fallout if one enters a contaminated area at a given time after fallout deposition is complete. (Data taken from the 1962 edition of the Effects of Nuclear Weapons.) If one enters a contaminated area two hours after burst, the dose rate will be less than 40 per cent of its H ≠ 1 hour value if deposition is incomplete and equal to 40 per cent of it if deposition is complete. The data in Table 6 indicate that a stay of 5 hours following this entrance would result in an accumulation of dose equal in numerical value to the H ≠ 1 hour rate provided deposition of fallout were complete. Thus at the boundary between Regions 2 and 3 in Figure 8 where the H ≠ 1 hour rate was 100 r/hr a stay of five hours would result in the accumulation of not more than 100 r, a dose that

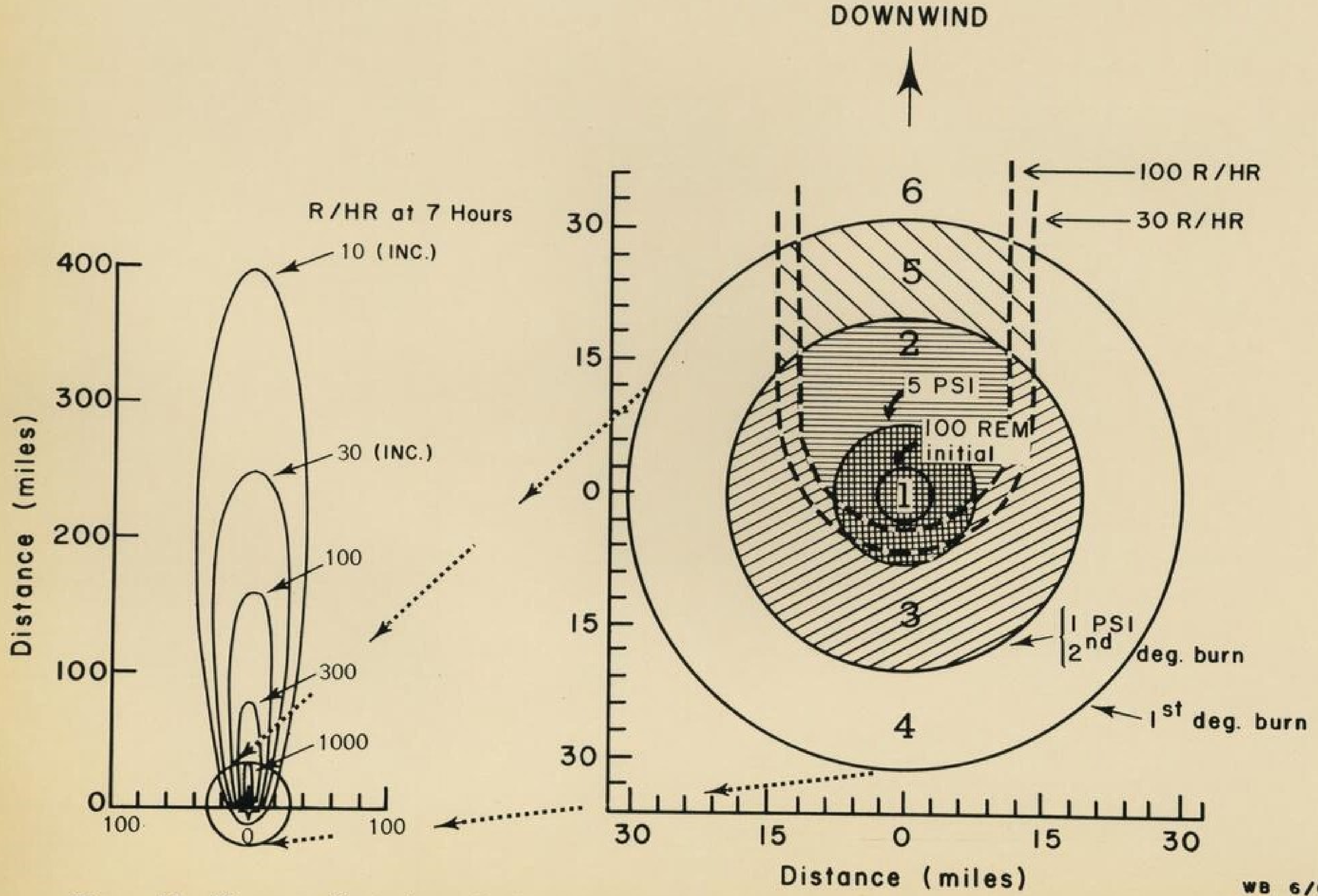

Figure 23. Weapons effects from the 20-MT surface burst of Figure 8 but giving reference dose rates at 7 hours after explosion. For distances of up to 100 miles downwind, but not beyond, actual dose rates are close to the reference values.

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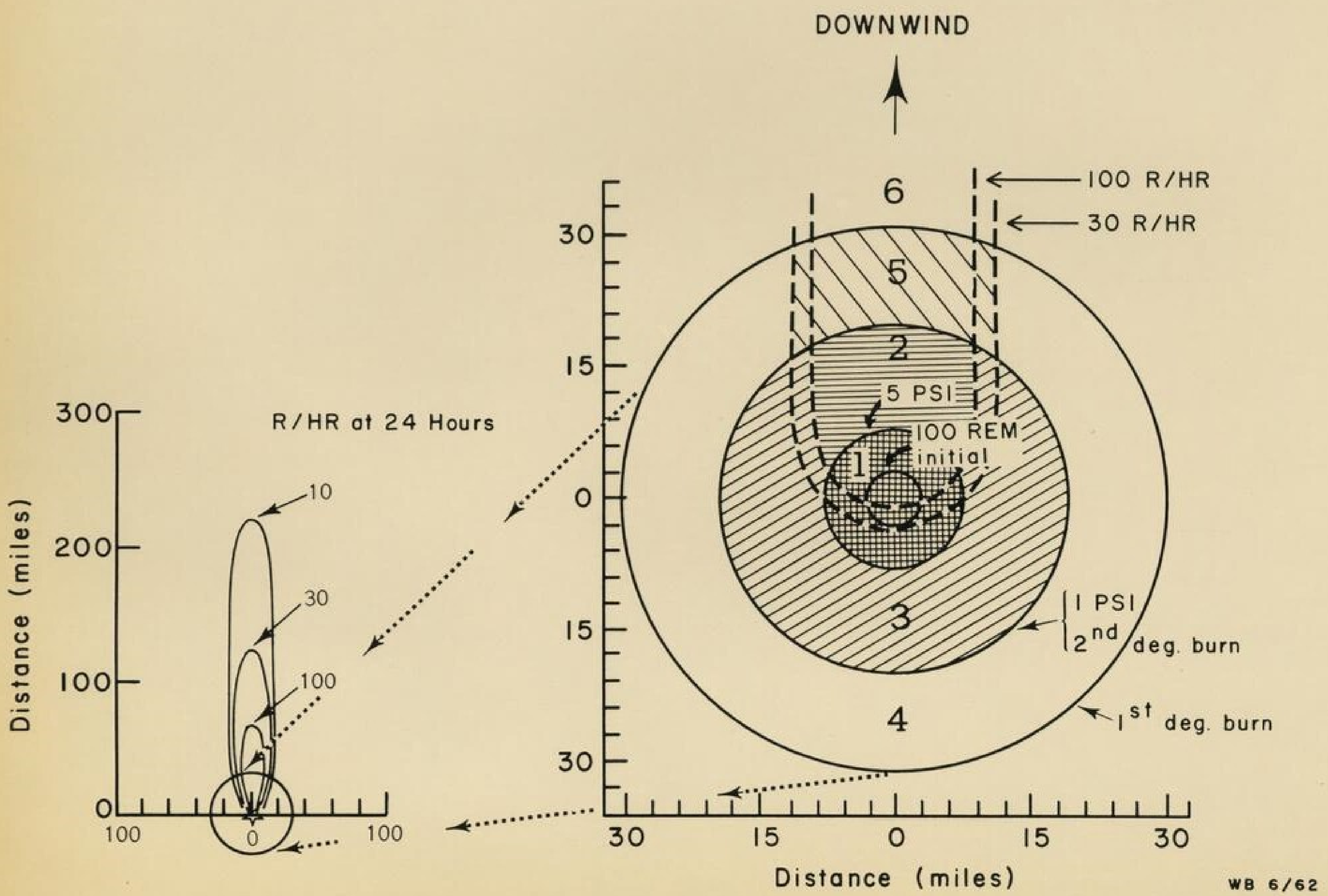

Figure 24. Same situation as for Figure 23 but for a time 24 hours after explosion. For this case the reference dose rates are close to actual values at all points.

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appears tolerable for emergency conditions, or at least no greater than the average dose to in-shelter inhabitants under an attack of the RISK I type.

TABLE 6

Percentage of Infinity Residual Radiation Dose that Would be Received if Fallout Deposition were Completed Immediately After Explosion. Differences in percentages are valid for all time intervals once deposition has ceased.

Time After Explosion (Hours)	Per Cent of Infinity Dose*	Time After Explosion (Hours)	Per Cent of Infinity Dose*
1	55	72	86
2	62	100	88
4	68	200	90
6	71	500	93
12	75	1,000	95
24	80	2,000	97
48	83	10,000	99

*The theoretical infinity dose is 9.3 times the theoretical H ≠ 1 hour dose rate in roentgens per hour.

In more heavily contaminated areas, re-entry would have to be delayed longer and the relative amount of time spent in areas of heavy contamination would have to be shorter. For example, if the initial dose were 1000 r/hr, it would take a day for the residual radiation to decay to the level of 40 r/hr which was reached in about two hours in the preceding case. For this case, due to the slower decay rate of the older fission products, a stay of only about 3 to 4 hours could result in a dose of about 100r.

In comparing these two examples, it is important to take into account the area covered by the assumed initial dose rates. The 100 r contour is as shown in Figure 8. The 1000 r contour lies inside the 100 rem initial radiation circle in the upwind direction and has a width of about 12 miles at the first degree burn line in the downwind direction.

The important conclusion from Table 6 as well as from Figures 23 and 24 is that about 80 per cent of the region of extensive (but not total) destruction is accessible to early entrance for rescue and fire fighting operations. Thus the possibility of large scale rescue does exist.

Rescue operations in the immediate post-attack period will require careful pre-attack planning and preparation if they are to be worth the effort. The crucial requirement is promptness. World War II experience indicates that two days represents the period in which large scale rescue efforts remain effective and even during this period the efficiency decays considerably; Canadian and U. S. Army assessments indicate that this is also true in nuclear attacks on cities. Another major requirement is trained and equipped rescue teams. A final requirement is trained and equipped fire fighting units prepared to meet the special problems of radioactive fallout and widespread disaster.

The conclusion to be drawn from this is that the whole possibility of substantial rescue of injured and trapped persons hinges upon having plans, training and equipment for prompt, efficient operation under quite unprecedented conditions. The ultimate life-saving utility of rescue operations depends on many other things--extensive radiation surveillance, decontamination, fire control, communications, traffic control, transportation, mobile first-aid stations backed by emergency hospitals, and the immediate restoration of essential services. Only the last two of these functions will be discussed in detail.

2. Medical Care

The management of the medical problems which will occur on the periphery of a target area has been relatively neglected in current planning; indeed, it does not seem that an appreciation of their probable magnitude is at all reflected in the current shelter program. Figure 23 shows that with the increase in weapon size very large numbers of casualties from burns and blast are to be expected in areas far beyond the zone of lethal direct radiation and well outside of that of serious fallout. Data presented to the Joint Committee on Atomic Energy by OCDM in 1959 suggested that two ten megaton bombs on New York would kill about 3-1/2 million on the first day, leave about 2-1/2 million fatally injured, and would leave about 2-1/4 million injured but capable of surviving if they receive adequate care (1950 population base). Since there are about 13 million people in the New York urban area, this would leave about 4-3/4 million uninjured, many of whom would presumably be in fallout shelters, but most of whom would be immobilized for one reason or another. Although the Panel is unable to assess the validity of the casualty data which are based upon extrapolations from the Hiroshima-Nagasaki experience and fully recognizes that gross variations would occur in actual attacks, the data are certainly suggestive of the character and probable magnitude of the medical problem in disaster areas. They lend strong support to the assertion that proper planning must assume that adequate medical care will be contingent on bringing in organized medical teams from regions exterior to the disaster area.

Data developed in the RISK I Study indicates that because hospitals are concentrated in central parts of urban areas, medical personnel and facilities are relatively more vulnerable than are other personnel and facilities. Thus the fractions of the medical personnel and hospitals which would be destroyed will exceed the fraction of personnel that would become fatalities. In the New York example (which was by no means extreme with respect to the relative fractions of immediate fatalities, delayed fatalities, or injured survivors in the city target areas examined) it would not be at all unreasonable to assume that at least one-half of the medical personnel in the urban area would be unable to function and that a similar fraction of the hospitals would be inoperable. If medical supplies are not given special protection through hardening or dispersal, they would likewise be greatly reduced. Thus, assuming for the moment that the data are reliable, the metropolitan area of New York City, under conditions of greatly reduced medical personnel, facilities, and supplies, could be faced with a situation in the urban area in which there were 4-3/4 million casualties, at least 2-1/4 million of whom required medical treatment--over a thousand-fold increase in the patient to doctor ratio,

To cite an example of a city with a much smaller population, it was estimated that if Bridgeport with a 1950 urban population of about 504,000 were attacked with a one-megaton bomb, 105,000 would be killed on the first day, 84,000 fatally injured, and 54,000 injured would survive. Thus Bridgeport would be faced with medical problems that were similar to those of New York both in character and proportion. About one-fifth of its population would die on the first day and their bodies would require disposal; an additional fraction of about one-third would be injured or ill, and slightly over one-half of this group would eventually die no matter what medical care was provided.

These two examples are chosen from a vast range of possibilities and there are many other possible examples in which the medical problem would be much less severe, but it is also possible that it could be much worse. Even if the casualty estimates were reduced by a factor of two or three, the principal problems to be faced--burial or disposal of the dead, first aid, medical care for the seriously injured--would remain the same and be exceedingly severe.

The more seriously injured either in shelters or at emergency hospital sites would pose social and psychological problems that would not have to be faced in undamaged areas. In any place where injured personnel had accumulated, and whether or not trained medical help were available, those present would be faced with a sick and injured population, many of whom would certainly die within the next sixty days. With skilled personnel and medical supplies at a premium the problem of triage or sorting of casualties for priority treatment would have to be faced. Effective sorting without a physician in charge would

be very difficult. Under most circumstances individual initiative would do the best it could to handle the problem. But organized care by suitably trained persons would undoubtedly greatly reduce potential fatalities as well as the social and psychological impact on survivors.

Current programs recognize that the shortage of trained personnel will result in enormous needs for medical self help and HEW is attempting to meet this problem with its proposal for the training of 50 million persons to assist themselves. The proposed training is primarily at the level of first aid and hence will in no way relieve the problem of caring for the seriously injured. Under present procedures ambulatory patients and other injured persons receiving help would very probably seek fallout shelter; however, the projected shelter medical supplies would quickly be exhausted. In particular, appropriate treatment for burns and other injuries would place such a drain on the restricted water supplies now being planned for shelter occupants (one quart per person per day) that uninjured occupants would be immediately imperiled. This will greatly magnify the problems of management and medical personnel.

In view of the projected shortage of physicians, specific medical aid training cannot be overemphasized. In fallout shelters and fringe area situations a course of training, possibly similar to that of military corpsmen, should be the goal. The use of all personnel trained in the healing arts is a clear requirement. Great efforts must be made to arouse members of the medical profession, the medical schools, and organized medicine to the magnitude of the potential problem. Methods should be sought to stimulate these groups to study and plan for mass casualty care problems. It is quite possible that a trained lay person, primed by the initiative and resourcefulness of a stress situation and equipped with a simple information source and ancillary aides may serve a function approximating that of the average physician in short-time emergency care. Their potential use, however, raises the particular question of who is to be given what training and that of stockpiling, distributing and using drugs that now require a doctor's prescription.

The use of semi-skilled personnel in a disaster situation such as this--one in which most essential services have been destroyed in addition to hospitals and normal medical supplies--appears to be beyond the capability of local and state organizations and to require a tightly knit organization with clear command and control if a reasonable degree of effectiveness is to be achieved.

There will undoubtedly be many situations for which the maximum saving of lives will involve large scale evacuation of impaired people to a better equipped hospital complex well outside the disaster area. However, it must be emphasized that a decision to do this involves effective command and control along with a detailed damage assessment and radioactive monitoring. This

too implies a tightly knit command organization. Since a particularly obvious site for these emergency hospitals is an Army base, the strong implication is that the Army might also supply the organization for the vital command and control.

3. Restoration of Essential Services

Concurrently with the provision of rescue (in the sense of removal from sources of entrapment and removal to places of immediate safety) and the establishment of emergency hospitals and the provision of emergency medical care there are several essential services whose restoration would have to be started immediately. Power is perhaps the most obviously needed service but communications, water, fuel, sanitation and food outlets are also essential.

The conditions under which these services will have to be restored, assuming a decision not to relocate the population, can best be visualized by considering the various damaged areas of Figure 8. In region of very great destruction (I) and also in regions of intense fallout (I, II, and V), restoration will be either very slow or impossible. In regions of only moderate or light blast damage and where the H + 1 fallout level is not over perhaps 500 r/hr prompt restoration will be entirely feasible. The great worry is that key main or distribution units will fall within an area of total destruction or extremely high fallout levels so that restoration in surrounding areas is greatly inhibited. The obvious countermeasure is to construct systems with large levels of redundancy and alternative circuits. But this must be done before the event in accord with careful planning.

Current plans assign responsibility for the restoration of essential services to state and local governments. Technical assistance is provided by Federal agencies. The Department of Defense would be responsible for providing emergency assistance to regions such as the ones pictured should the affected states require it; it is the view of the Panel that such assistance most certainly would be required, since it appears to be decidedly uncertain whether state and local organizations will be developed to the point where they are capable of coping with the problems so far discussed.

4. Organization for Disaster Control

It is evident that the ultimate life-saving utility of rescue operations depends on many factors. Among these are radiation surveillance, fire control, emergency medical care, and the restoration of essential services. All of these functions will have to be performed by small units of

trained personnel able to make use of untrained help. These units in turn will have to be tightly integrated and under effective control if the whole chain of operations is to succeed in meaningful rescue within the first day or two.

Such demanding requirements clearly necessitate a complex structure of trained and rehearsed teams with a firm chain of command. The integration of this structure into an over-all effective system requires a disaster control plan tailored to the details of each population center, yet flexible enough to bring maximum resources to bear at the variable points actually attacked. For an effective program the following appear to be essential:

a. The development of a disaster control plan.

b. The development, training and equipping of appropriate teams.

c. Stockpiling of essential supplies and prelocation of emergency hospitals.

d. Provision for effective command and control.

e. Enough realistic rehearsal to maintain a state of preparedness.

The question is, how is an effective program to be developed and maintained? The current proposal is that this should be done by local civil defense organizations utilizing the conventional fire and police departments and local hospital teams, supplemented by volunteer personnel. We have growing doubts that this will result in an effective program, even if the state and local organizations are provided plans, technical assistance and equipment by the Federal Government to a degree beyond that now contemplated. It seems inescapable to us that one must look to a larger and more highly organized group, capable of developing the core of these capabilities and sufficiently disciplined to carry out such duties under conditions of extreme difficulty. This leads directly to the suggestion that such an organization can be found in the active and reserve forces of the Army supplemented by other military forces and the National Guard. To pose the assignment of such a responsibility to the Army requires first that the use of the Army for such work during the early post-attack period be justified and second that the responsibility be clearly defined.

Why should the Army and other military forces be used for such work during the early post-attack period? In the first place, it is traditional to

use the Army to assist civilian authority in times of disaster. This tradition goes back to pre-Civil War days, for the Army has always been the means through which Federal assistance was provided when disasters could not be controlled by the state and local governments. The period following a nuclear attack is certainly of this type. Not only are the operations of the Federal Government subject to great uncertainty, but those of state and local governments are perhaps even less assured. The important point is, however, that it is in the disaster area itself where Governmental authority is most likely to break down and organized assistance can only come from the outside.

A second reason why the use of the Army can be justified lies in the magnitude of the disaster itself. It is inconceivable to the Panel that in the kind of disaster area resulting from a large nuclear explosion, the adjacent Army units could avoid the assignment of responsibility to assist. Under current possibilities this would be done by placing themselves at the disposal of the sheltered civil defense organizations. It seems far more plausible and realistic to us to assume that the Army, whose units are dispersed and more easily protected than the general population, would in part take command, though it should remain under civilian control at some level. A modest corps of active Army personnel, bolstered by called-in Reserves and the National Guard with equipment, communications, and bases could be enormously more effective in carrying out the complex problems of rescue, medical care, and restoration than any organization which we now see available.

The Panel's tentative belief that responsibilities can be so clearly defined that the use of the Army and other reserve forces might be feasible is supported by the favorable experiences of both the British and the Canadians. The Canadian Army reserve forces have a direct responsibility for national survival, and so do the British Territorials. Both groups report that civil defense responsibility was initially strongly resisted. However, after an interval of about a year, the situation reversed: morale and enlistments increased, and civil defense training, in particular in rescue operations, is considered to be a proper military role under modern conditions.

A detailed study of the use of the Army or of some segments of it is clearly beyond the scope of this Panel. However, we do think that both the character of the post-attack problem and the organization and deployment of the Army and of its reserves are sufficiently compatible to suggest that a serious study would be useful.

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B. Post-Attack Recovery Problems

1. Continuity of Government

The maintenance or restoration of the major functions of national, state and local governments is vitally necessary for the proper conduct of post-attack and recovery operations: Federal responsibility for these tasks is assigned to the Office of Emergency Planning.

Specifically, the OEP program seeks "to maintain governmental authority, leadership, and structure by strengthening governmental emergency operational capability." These goals are sought through activities directed toward: (1) the establishment of automatic lines of succession for key officials; (2) the establishment of emergency operating centers; (3) the preservation of vital records; and (4) the effective use of government personnel and facilities. Advances in weapons technology, the consequent increase in anticipated destruction, and the possible decrease in warning time make the achievement of these goals increasingly difficult.

The Panel has reviewed the Continuity of Government Program, though not in the same detail as the OCD program; the briefings received, the OCDM 1961 Annual Report to the President, and the review of other agency and departmental programs suggest that some serious problems exist in this area.

OCDM concluded at the end of FY 1961 that provisions for automatic lines of succession of Federal officials were adequate but indicated that this was not the case for state and local government officials. It is clearly necessary that lines of succession be established. However, the determination of a need to transfer authority and the actual transfer or relocation of authority during an emergency depend also on provisions for communications, for alerting responsible officials and for transporting them to relocation sites, and on the protection provided after they arrive. Provisions for emergency operating centers for the Federal Government are recognized to be quite inadequate and OEP has this problem under intensive study at the present time. Federal agencies designated 432 emergency relocation sites for field operations prior to the end of FY 1961; however, each agency has a separate single primary site and none of the emergency centers has adequate protection against blast or fallout.

State and local government programs for emergency operating centers demonstrate an even lower level of preparedness. OCDM estimated that in

July 1961 there were seven states that had protected emergency operation centers, seven that had such facilities under development and the remaining 36 had designated "unprotected" sites. Counties and cities have relatively far fewer protected centers. OCD states that as of 1 January 1962, a total of 40 state and county protected centers were under construction and a total of 24 had been completed. Unprotected state and local centers (as well as Federal centers) have generally been located in areas expected to be free of blast effects; however, current plans do not include fallout protection.

The principal Federal emergency operation centers are located within a 300 mile circle centered on Washington and are usually manned with skeleton administrative and communications staff. It is anticipated that these will be augmented by emergency staff adequate to carry out the functions of the parent organization should its headquarters be destroyed. Critical personnel will be transferred should warning permit.

Plans for warning and alerting of critical personnel vary in quality within the various agencies and departments. In some instances detailed warning procedures have not yet been specified, though progress in the last year has been rapid. In most agencies current plans assume telephone contact after receipt of the primary Federal warning though some plans are formulated on the assumption that personnel will act on receipt of public warning also. Considering the possible locations of emergency staff at time of tactical warning and the location of primary emergency centers, it is doubtful that staffs would be complete unless warning was received several hours prior to an attack. As for vulnerability during transit and immediately after an attack has begun, the RISK I Study estimates that shortly after an attack over 95 per cent of the population in the District of Columbia will become casualties. This particular assumed attack led to peak overpressures exceeding 10 psi for the entire metropolitan area and unit time reference radiation intensities in excess of 3000 r/hr at H ∤ 1. From these data, OEP concludes that all National Government headquarters in Washington, D. C. are virtually certain to cease to exist. Unless Washington, D. C. personnel are outside of D. C. at the time of impact, casualties in transit to field establishments are certain to be high. Furthermore, about 90 per cent of Federal field personnel with executive responsibility is concentrated in 14 large cities; consequently, in attacks with a substantial antipopulation component it must be expected that Federal offices and field personnel will sustain much higher proportions of casualties than the population in general.

The situation at state and local levels appears to be somewhat better with respect to vulnerability in that dispersion is greater; however, in the

RISK I Study in which state capitals were not targets per se, 28 state capitals were subjected to very high overpressures and 27 of these were also subjected to lethal fallout doses. Thus, it must be concluded that if the only warning is a tactical one, in many instances emergency staffs at state and local governmental levels will also be very incomplete.

The potential shortage of trained staff, the lack of fallout and blast protection at proposed centers, the centralized character of both normal and emergency Federal operations centers, and the lack of alternate centers, preferably mobile in nature, all combine to cast great doubt on the potential effectiveness of early post-attack operations at all levels of government, especially during the period when fallout hazards are assumed to be high. The lack of fallout protection makes most emergency centers uninhabitable immediately after a heavy ground burst attack; the lack of blast protection at critical centers and the lack of alternate centers make it possible for a very small attack intentionally directed at the control structure to interrupt for an extended period practically all essential Federal non-military functions and to at least partially destroy the records and manpower essential for their early restoration. The situation may improve at the state and local levels as a result of current OEP and OCD programs urging the construction of protected centers; however, considering the past response to matching funds programs (of which there is already one for the construction of state and county emergency centers) and the OCD prediction of six new starts in FY 1963 for states and 25 for counties, it appears that the immediate prospects at state and local levels are poor. Because of this, capabilities for civilian governmental operations in the immediate post-attack period appear to be quite low and to be highly dependent on warning and on type of attack.

In short, the Panel has serious reservations that the vitally important function of maintaining ability to assert governmental authority and leadership at Federal, state, and local levels can be effectively carried out in the immediate post-attack period. Capability to restore major Federal and other governmental functions in a reasonably short time is doubtful.

2. Allocation of Reconstruction Effort

Reconstruction (including evacuation from shelters, relocation, welfare and medical services, and restoration of production and distribution) is highly dependent on the proper allocation of residual resources, including manpower. In its brief review of this area, the Panel has received little evidence that the allocation function can be executed with a reasonable degree

of effectiveness. Basic information needed for efficient allocation of effort must be derived from a combination of the pre-attack data base and assessments of damage. The data base and the damage assessment capability are discussed in Part I where serious deficiencies in both are indicated. The Panel has severe reservations that the needed data will be available, and hence, lacks confidence that proper resource allocation can be made.

Programs are being developed to utilize the data that are likely to be available; however, in many instances these are based on stand-by organizations whose philosophy is "to do the best we can with what will be available." But estimates of "what will be available" are clearly needed if planning is to be on a sound basis; such estimates require detailed system studies and these have not been done. Even where prior system analyses are now being made, inadequate attention is being given to bottleneck and interaction problems.

3. Restoration of Production and Distribution

The re-establishment of a functioning system for production and distribution of goods and services is one of the key operations to be performed in the post-attack period. In terms of long-range plans this is the responsibility of OEP, but some parts of the problem are essential even from the point of view of the short-run survival period--the maintenance of electric power, for example. Here the division of planning responsibility between OEP and OCD appears to be unclear.

The analysis necessary for the establishment of rational plans for the restoration of production and distribution has not yet been completed. Although evaluations of damage to plants, facilities, and manpower have been attempted, assessment of demands and of actual production capability are recognized to be inadequate. OCDM in its 1961 Report to the President makes the surprising statement that "supply-requirements studies to date have made no differentiation between requirements of limited and general war because sufficient basic nuclear bomb-damage analysis data have not been available." Nuclear attack data are now being obtained and models are being designed to measure the impact of nuclear attacks on the total economy. Improved nuclear attack data and models would greatly facilitate construction of sound plans for the restoration of production and distribution. Moreover, pre-attack measures that would simplify and facilitate post-attack recovery are also difficult to determine in the absence of good post-attack models.

Under existing plans, restoration of the critical activities of power and fuel have been delegated to the Department of the Interior, food and agriculture

to the Department of Agriculture, transportation and general industry to the Department of Commerce and medical services to Health, Education, and Welfare, etc. The success of these agencies in meeting the assigned tasks has been highly variable and by no means proportional to the criticality of the activities involved. In the next section some specific observations on the present status of several agency planning efforts for the post-attack period are set forth.

4. Agency Programs for the Post-Attack Period

a. The Program of the Department of Agriculture

With funds of approximately $300, 000 per year, it is quite understandable that the Department's program is not yet well advanced. The rural information and assistance program, for example, is allocated only $60, 000 a year; yet the USDA has the responsibility of providing technical and other information and assistance to the entire rural population. The scale of this effort appears to be unrealistically small.

There are three additional program items that appear to merit special comment: plans for feeding the Nation during an emergency; basic rural civil defense plans; and plans for coping with major ecological problems.

(1) Emergency Food Program

Plans for feeding the Nation following a shelter period appears to be in the data collection stage, inasmuch as the normal distribution patterns for supplies in individual homes, in retail stores, and wholesale warehouses have not yet been determined. Thus it is impossible to estimate with accuracy what fraction of the population will require emergency food at various times during the shelter and post-shelter periods, and where and how such requirements could be met. The quantitative basis necessary for stockpile planning and food distribution and analysis and planning has not yet been obtained. The recent move towards more practical distribution of grain storage is clearly a step in the right direction, but we do not yet appear to have a rational plan for the restoration of food distribution.

Since about 40 per cent of the Nation's food is not preserved at all, a key element in restoring food distribution lies in the continuation of food production, and hence with the farmer; however, insofar as the Panel could determine, plans for the survival and rehabilitation of farmers and livestock are inadequate.

(2) Rural Civil Defense

The problems of rural families differ significantly from those of urban dwellers, yet the distinction in current programs is not clear. For example, Department literature indicates that the philosophy of rural recovery operations following a nuclear strike relies heavily on actions to be taken by county agricultural agents. The farmer is advised to wait until the county agent arrives and tells him which meats are contaminated, which land can be safely used, which water is uncontaminated, etc. In nuclear war, the farmer may not be able to wait for, and should not have to depend too greatly on the arrival of the county agent in order to take protective measures or to initiate post-attack procedures. What appears to be needed for the farmer is a more intensive self-help training program for periods following an attack and a reduction of dependence on uncertain outside assistance.

His shelter may also be somewhat different in character since, in general, he may expect a somewhat greater warning time, has equipment not available to urban dwellers, and generally has larger stores of food on hand. For example, he can make greater use of hastily constructed shelters than can his city counterpart. These would be especially helpful in preserving livestock, however, prior plans and instruments appear to be required. Planning to date has not advanced to the point where such factors are included.

(3) Major Ecological Problems

Large scale attacks are expected to have major ecological consequences which have not been given detailed study by appropriate agencies, but since the Department of Agriculture is most closely related these observations are included here. Radiation and fire can seriously upset the balance in nature that has developed within and between animals and plant species. The effects of fire will set into motion forces of erosion that could change the national landscape in a major way. Various animals and plants show unequal sensitivity to radiation effects; hence, it must be anticipated that the interdependent food and reproductive cycles will be interrupted in numerous places. Fires are expected to destroy the natural habitats of certain species and the food sources of others, and thus to result in migration and movement of animals to non-affected areas. The timing, extent, and effect of such movement and the type of symbiotic balance that would be restored cannot be predicted on the basis of available study results, especially when selective absorption of fallout and its probable effects are taken into account.

The situation with respect to erosion is less complicated, but still not sufficiently well known. The removal of turf, the possible destruction

of forests by fire, and the potential loss of vegetation on grasslands and prairies have consequences that can be speculated about with some rationality; however, the seriousness of the erosive effects will vary considerably with the type of attack and with the season in which it occurs. The Panel has received inadequate data to permit detailed assessment.

Statements by ecologists lead us to expect that some form of vegetation will ultimately replace burned-out forests and that some type of plant-animal balance will eventually be restored; yet the intervening stages are not determined and the effect on possible recovery programs not taken into account. For example, there are judgments that forests whose primary species are the result of 400 - 500 years of uninterrupted growth will require on the order of 1000 years for complete replacement. But what happens in the initial 5 to 10 years? To what extent will dust bowls be extended and new ones formed by fire damage to grasslands? What are the ultimate effects of repeated spring thaws even in areas subjected to moderate removal of turf? These are some of the questions about long-range ecological effects for which answers appear to be completely inadequate.

In short, the Panel is deeply concerned that this area has received so little attention, and believes that prospects for ultimate recovery cannot be realistically assessed until some of the unknowns are resolved and appropriate conservation and protective programs planned.

b. The Program of the Department of Commerce

The activities of the Department of Commerce are critical to the performance of the total civil defense system, particularly in the immediate post-attack period. For example, the data provided through meteorological and fallout forecasts are to be utilized as the basis for predicting heavy fallout areas, and hence for many urgent civil defense decisions during and following an attack. The emergency control of transportation is a prerequisite if movement into and evacuation from disaster areas are to be feasible. The reestablishment of production and distribution systems, and the related establishment of requirements for critical civil defense stockpiles, interact with such other agency programs as fuel supply, to provide much of the basis for post-attack recovery.

Comments:

The principal emergency preparedness programs of the Department of Commerce appear to be oriented toward mobilization for limited war or

towards peacetime operations to such an extent that the vital area of general war preparedness appears to have been accorded too low a priority. There are paper plans, but no funds, organization, or programs to make the plans implementable. The Bureau of Public Roads, for example, has an emergency transportation plan, but no funds to permit the stockpiling of emergency signs for highway marking. The Weather Bureau relies on reports from about 330 weather stations throughout the country to make its meteorological and fallout predictions; these are extremely vulnerable and hence their loss must be anticipated at the time of greatest urgency. Similarly, the Business and Defense Services Administration, which receives about 60 per cent of the Department's emergency preparedness funds has a well developed program for limited war mobilization (in addition to that for assuring continuance of priority production during peacetime), but just only quite recently has conducted a survey to determine its capability to function as an Emergency Production Board in general war. These examples are symptomatic of a low level of program development for post-attack operations.

c. The Program of the Department of Health, Education and Welfare

The procurement of stocks, planning, and management of the medical stockpile account for $40 million of the $42,106,000 FY 1963 funds requested for emergency HEW functions. The remaining funds are allocated to other functions in the emergency medical field for the post-strike situation, where there will be severe shortage of medical services relative to the greatly expanded need for medical care.

Comments:

In this area, the current program emphasis on bringing responsibility down to the local health-group levels, in terms of distributing whatever trained medical personnel and hospital facilities may be left, appears wholly proper. However, the distribution of analgesics, antibiotics and other agents for the control of traumatic casualties, should also be the responsibility of HEW, but is not contained in the current program.

The HEW program calls for national indoctrination on medical care (primarily at the level of first aid) in the individual family. It also seeks to train instructors for state schools giving courses in emergency medical and welfare services. Unfortunately, however, there seem to be so many unresolved questions as to (1) the level of medical responsibility which can be assumed by trained nurses and lesser trained individuals in an emergency, and (2) how to train such individuals in peacetime to assume responsibilities normally reserved to the medical profession that the plans for this training may not be at all adequate.

3a

d. The Program of the Department of the Interior

The availability of energy is extremely critical in the immediate post-attack and recovery periods. This availability will be determined largely by: (a) hardening of the essential systems elements; and (b) post-attack plans for the restoration of energy sources.

Hardening measures remain the responsibility of private industry with the Federal Government providing technical assistance and advice. There is no evidence that such private efforts are in fact being carried out; moreover, the Department staff is inadequate to monitor and coordinate such measures. Furthermore, no adequate studies assessing the vulnerability of the total energy supply system exist, nor is there any research program on hardening measures.

The post-attack plan relies primarily on the direction of an "executive reserve group" whose availability in the post-attack period is far from assured.

In summary, the current plan carries an air of unreality when viewed in the light of nuclear war, and we have grave doubts that this critical area has been adequately considered in current plans.

5. Summary Comments

The Panel doubts whether the net sum of existing recovery programs amounts to an adequate plan for economic recovery. Such a plan would involve vulnerability reduction for key facilities and personnel and stockpiling of items essential for restoration of services and production. It would also involve a classification of activities according to post-attack essentiality, with a corresponding allocation of protective effort.

C. Problems Not Considered by the Panel

There are several important problems that have not been considered by the Panel, either because they were clearly outside of the scope and competence of the Panel, or because the lack of available time or data made their treatment appear unprofitable. Principal among these are the BW-CW program, emergency housing, manpower, restoration and relocation of cities, fiscal and indemnity problems, and long range somatic and genetic effects.

VII. RECOGNIZED DEFICIENCIES IN TECHNICAL BACKGROUND

Discussions in the preceding Parts have shown that, as in many areas of military technology, the U. S. is forced to make decisions in the Civil Defense area in the face of incomplete technical information. The uncertainties are of various degrees of importance, ranging from problems affecting only technical details of the program to uncertainties concerning the long-range survival of the nation itself. As in other military-technical problems, the U. S. is involved in a situation of changing technology and a live opponent; the Panel believes that a considerably larger and better coordinated research program should guide the Civil Defense program. The particular problem areas summarized below represent those that appear most critical, but a more comprehensive survey may sharpen the list and add others.

A. Long-Range Effects - In Particular, at High-Attack Levels

The U. S. is faced with the problem that at high-attack levels--say, 20,000 MT delivered (which could easily become a threat in less than a decade)--there is lack of confidence in even the approximate validity of the various damage analyses or in the assessment of the value of shelter measures. This ignorance stems from two sources: i) at large attack levels, the long-range somatic, genetic, and ecological effects, such as ecological and genetic damage, may become determining factors in our ability to survive as a nation, but have hardly been studied; ii) considering the complex interrelationships in our society, damaged components cannot be considered to act independently, and the actual damage may very seriously depend on the combination of the various primary effects.

1. Somatic Effects

In the post attack world, we would be faced with unprecedented problems of medical care. Assuming even modest effectiveness of rescue and care of casualties, there would probably be many millions of persons who had become permanently handicapped physically, who had received high radiation doses, or who were mentally disturbed from the traumatic experience of nuclear war or suffered from combinations of these effects. Each of these three classes present special problems in mass medical care. Beyond this, if the major portion of the surviving

population were in this condition, the provision for their care and the possibilities of their leading useful lives would become related to long-range national recovery itself. The question that arises from such considerations is whether research and further study could provide any guide and aid to these kinds of problems. It seems clear that the medical problems arising in high radiation exposure are open to continuous study in order to see if such problems as weakened immunological response and increased incidence of carcinoma can be solved. A more general problem is the over-all health hazard arising from long-term exposure of large populations to radiation levels many times that of the present background. In a larger sense, the whole range of problems of a large population subject to the special kinds of injury and illness attendant upon nuclear war needs careful evaluation and scrutiny with respect to what areas may be alleviated by further investigation or planning.

2. Genetic Effects

A 3,000 MT attack was estimated to expose the fraction of the U. S. population which is not among the direct casualties to an average integrated radiation dose of about 100 r. Although estimates in this area are subject to great controversy, this exposure is expected to double the naturally occurring mutation rates leading to a corresponding increase in birth defects, etc. Noting that about 2% of all births now involve some defect, this in itself is a serious but not totally disastrous consequence of nuclear war. If the total exposure is now increased by another factor of, say, ten, we are simply not in a position to estimate either total casualties or the long-range genetic consequences. In particular, the question as to the extent to which defective elements will be eliminated from the species by their lack of ability to survive or whether the number of mutations will be so large as to affect profoundly the nature of future generations appears to have no established answers.

3. Ecology

In looking toward the possibility of very high delivered yields in the future, we are faced with the question whether the effect of general damage on natural processes and interrelationships may not in the long run exceed the problem of short-range survival.

Different natural species exhibit a large degree of variation in their sensitivity to radiation exposure. For instance, conifers are particularly radiation sensitive, exhibiting substantial lethality at levels of several hundred r. Other species are considerably more resistant. If

we note that a 20,000 MT attack would give an average exposure approaching 1,000 r, we would thus expect an extremely serious immediate upset of the balance of nature. The balance would be further destroyed by selective absorption processes. The extent of these effects can only be surmised; e.g., destruction of certain forests would lead to erosion, shift in water flow patterns, etc. At this radiation level very large fractions of the wildlife and farm animal population would be destroyed. With the exception of some work under AEC auspices, very little work is being done to make it possible for us to assess the attack levels at which ecological damage of this type would have disastrous consequences.

We were encouraged by the AEC's interest in the long-range biological and ecological effects of large scale attacks on this country and support their recent decision to undertake an expanded research program in these areas; the seriousness of these problems is such that extensive studies should be encouraged, including appropriate efforts by other agencies.

B. Weapons Effects

1. Blast and Fallout

With the important exception of thermal effects, and to a perhaps lesser extent fallout distributions, knowledge of nuclear weapons effects is sufficient to permit prediction of primary effects of nuclear explosions to an accuracy reasonably adequate for planning.

Blast-yield relationships are well established, and some of the basic principles of fallout prediction are fairly well understood. However, observed fallout patterns exhibit large local variations from the predicted pattern; this leaves unresolved the questions to what extent local use of detailed radiation measurement and protection by available structures could decrease radiation casualties. Moreover, fallout prediction is directly dependent on the quality of meteorological forecasting of high-altitude winds. Little is also known about the chance of natural decontamination due to wind, rain, etc. It is noted also that most of our meteorological forecasting stations would be destroyed in an attack of the type considered by the RISK I study.

2. Fire

The situation is much less definite in the case of fire damage; it is noted again that none of the damage assessment and casualty studies have taken fire damage into account.

It is noted that the phenomena of fire development and spread of a conflagration front or development of fire storms are dependent on wind, humidity, built-upness of the area, but we do not have quantitative relations. Even the projected data base does not provide the needed information and theoretical relations are not well established--neither for conflagrations or for fire storms. Fire storm, as a problem in meteorology and fluid dynamics, must receive serious study.

Another deficiency is the lack of quantitative knowledge of the extent of oxygen depletion or air contamination (carbon dioxide, carbon monoxide, smoke, and other fumes) in large-area fires. They can be guessed at, but the relation between the area involved and its built-upness with combustible structures which causes respiratory difficulties at the center of the area is not known.

There does not exist a model for properly including fire effects in bomb casualty studies; the Thermal Sub-Panel will address itself to this problem among others. Moreover, it is not known how to estimate reliably the number of probable ignition centers in built-up areas, as influenced by the magnitude of the received thermal impulse or the prophylactic treatment of the area.

The proposed OCD research program on fire is inadequate, considering how little is known about large fires. A total of about $1 million specifically for fire research of a research budget of about $16 million, with a quite negligible expenditure on a fundamental understanding of fire growth and spread, is a measure of the lack of recognition of this serious defect in our knowledge.

3. Validity of Damage Studies

Studies which attempt to assess the combined effect of model nuclear attacks, however extensive, will always be limited by their assumptions concerning the nature and level of enemy attack and many other unpredictable factors. However there are defects which can be corrected - such as:

a. Neglect of fire effects (see above).

b. Lack of detailed point-by-point and system studies.

The major studies supporting current programs - in particular the RISK I study - treat the loss of facilities and industries on a

statistical basis depending on the vulnerability of each separate industry. In so doing they neglect the interdependence of the various essential services, such as food production and transport, the dependence of transport on gasoline availability, the dependence of gasoline availability on electric power, etc., etc. (The PAMUSA study was a notable exception in this respect.) Moreover, the studies ignore the vulnerability of the various industries as a system - e.g., only the power generating capacity rather than the complete power distribution system (including distribution) is considered in assessing availability of electric power.

The most detailed point-by-point civil defense study known to the Panel is the British study of a 1 MT ground burst in Birmingham; this study examined the survival of essential services, their interrelationships, etc., in considerable detail. The conclusions were considerably more pessimistic than in the less detailed U. S. studies. As a result, the Panel's quantitative confidence in the large U. S. studies is quite low; it is believed that studies of sufficient detail to identify "bottlenecks" in the post-attack survival problem and assess their implications are essential to lend more meaning to U. S. studies. Specifically, we need studies of the post-attack situation which take full account of the complex interrelationships among the essential services in our society. Such studies will be a very extensive undertaking if they are to be meaningful.

The Panel was informed that OEP may initiate a detailed study of probable damage in the Boston area under a variety of attack conditions, and of methods of restoring essential services in the immediate post-attack period. In contrast to previous studies, this one would focus on the system aspects of utilities, sanitation, and sewage, etc., and would give due consideration to the effects of fallout and the in-shelter stay of personnel on these systems, and conversely to the effects of damage to the systems on the in-shelter inhabitants. The Panel suggests that the medical implications of these attacks must also be examined in great detail, and believes that studies such as these are essential to a proper understanding of the in-shelter and immediate post-emergency periods. We urge that such studies be undertaken without delay.

c. The feasibility of rescue.

With the exception of the PAMUSA study, the British Birmingham study and some Canadian studies which are difficult to apply to U. S. situations, little is known about the feasibility of re-entry and rescue in the face of fallout and other dangers. In sharp contrast to the British study, Canadian studies and the PAMUSA study, conclude that

rescue and re-entry are feasible over an arc of about 270° except for a relatively small area close to ground zero. Although the Panel's assessment of the feasibility of rescue agrees more with those of the U. S. Army and Canada than with the British studies, the techniques of rescue require additional study.

d. The degree of shelter utilization under actual conditions.

Studies on the utility of fallout shelters generally compare survival for unsheltered populations and for populations making 100 per cent use of available shelter. Little is known about reasonable estimates of expected utilization of a given shelter distribution, nor is allowance made for either evacuation or flight of urban populations due to rising tensions or escalation of limited war.

e. The calculation of protection factors (PF).

Although our understanding of protection factors in the moderate protection range seems adequate to guide the shelter-making program, we are impressed by the lack of even a few experimental "spot checks" on the validity of the vast computational program.

Protection factors of existing structures are being calculated, as part of the current stocking and marking program, using a simplified computer program developed by the Bureau of Standards. Relatively few experimental measurements on actual structures during weapons tests and using radioactive sources have been made, and -- to the best of the Panel's knowledge -- inadequate checks between measured structures and the presently used computer program have been made. Nevertheless, the Panel believes that the accuracy of the PF's computed for PF values less than 100 is probably within a factor of two and for larger values of the PF (where the actual value is less important) within a factor of three or four. Although these uncertainties may not be serious, improvement -- in particular in relation to experimental check points on the computer procedure -- is clearly desirable.

4. Biological Effect of Radiation

The effect of fallout radiation is generally computed in terms of an "effective biological dose" (EBD). This dose is usually computed by assuming that (1) no recovery occurs to damaged biological systems for the first four days after exposure; (2) recovery occurs after four days at the rate of 2.5 per cent per day for 90 per cent of the exposure; and (3) 10 per cent of the exposure results in irrecoverable damage.

There is little experimental or theoretical information to back up these assumed recovery rates. In particular, few significant data exist on experimental radiation exposures to animals on a time scale comparable to the fallout situation. Even though the relation from animal to man would give an unavoidable uncertainty, information on the rate dependence of biological damage in animals could be related to the information on short time exposures on animals vs. man where some data exist.

The deficiency of knowledge about biological radiation damage at rates corresponding to the fallout situation is serious in assessing the relative value of radiation protection factors of various structures. If larger doses are, in fact, tolerable, the optimum use, guided by radiation readings, of basement or other available shelter may under some circumstances be preferable to special construction; moreover, the number of shelter spaces identified by the current marking and stocking program and the accuracy required for protection factor estimation depend strongly on the standards adopted for a useful protection factor.

The uncertainty of the rate dependence of biological effects (and to a minor extent the inaccuracy of calculation of radiation protection factor) combined with the rapidly diminishing value of very large protection factors is considered to be a very serious deficiency in knowledge. In the face of this ignorance it is difficult to judge the merit of an extensive fallout shelter building program (without blast and fire protection) vs. a program of informing the public on the optimum use of existing structures.

An intensive program on biological effects of radiation accumulated over a period of days or weeks, and on the repair of various kinds of radiation-induced biological damage is urgently needed.

5. Psychological and Social Effects

a. Effect of Civil Defense Programs on Public Attitudes

It is the area of psychological effect of an extensive civil defense program where there is possibly the greatest controversy and least documented knowledge.

In discussions the Panel has considered civil defense primarily as a means of increasing survival under nuclear attack, should it occur. The question of whether the existence of a civil defense program

3a

will have a direct effect on the chance of such an attack occurring has been discussed in Part IV in relation to alternates in military policy. Related to this question is the problem of the influence on U. S. civilian attitudes in peacetime. There the U. S. is faced with a dilemma: to be most effective, a civil defense program demands considerable involvement of the population in civil defense training and other activity. To achieve such involvement, a program has to be "sold" to the public. If such persuasion uses arguments of "You can survive" type, false assurance and greater acceptance of nuclear war might result. If persuasion emphasizes the horrors and dangers the U. S. now faces, precisely the opposite result might arise -- e.g., the population might be more receptive to arms reduction measures. Hence the psychological response is very difficult to predict and is possibly dependent in detail on the civil defense public information program which at present is not well coordinated and controlled.

There is evidence that preparation for disaster leads to increased acceptance of its likelihood; it is not known how applicable such data are to this problem on a national scale, nor are the changes of attitude that would accompany such acceptance well known. <u>The questions in this area must be listed as an area of profound uncertainty but of great importance.</u>

b. <u>Population Behavior in Disaster</u>

It has been recognized that a realistic assessment of the value of a shelter program and in fact any civil defense program must include an evaluation of the expected response of the population to warning, its ability to behave rationally to disaster, to create and/or accept leadership, and to maintain law and order. These questions are inter-related to the effectiveness which can be expected from training a segment of the population.

Relatively little is known about these problems since the scale of the disaster in nuclear war would transcend all past experience. In general, studies of population behavior in past disasters have shown relatively little irrational behavior; on the other hand, such disasters have most often been in a limited area surrounded by unimpaired communities that could be expected to provide quick rescue and assistance. Hence such questions are not expected to have reliable answers. In particular it appears very uncertain how undisciplined individuals will behave in disaster when conflicts of responsibility to family, personal survival or assistance to others arise. These and other factors make it impossible at present to assess realistically the extent to which community shelter would actually be used.

A further unknown is in-shelter behavior. Tests with volunteers or military personnel have provided useful data on such physical factors as temperature, humidity, and space, but have been fairly meaningless in the behavior area since the stress factors under actual conditions cannot be simulated. Research aimed at the behavior of populations in disaster should be encouraged.

VIII. THE PROBLEM OF ADMINISTRATIVE AND FISCAL RESPONSIBILITY IN CIVIL DEFENSE

Having examined in some detail the tasks that confront civil defense, the effectiveness of current programs and the state of the technical components, it would appear that the appropriate time for summarizing and concluding was at hand. However, in the course of this largely technical review of civil defense it became increasingly apparent that the effectiveness of every technical component depended upon its availability and the organization which was responsible for its proper deployment. In this way it was inevitable that the Panel became concerned with the administrative and fiscal aspects of the civil defense program. The Panel's observations on the funding and and the division of responsibility and coordination among Federal, State and local government agencies are set forth in this part, prior to presenting our other conclusions in the following and final Part.

A. State and Local vs. Federal Responsibility

1. General Problems

Traditionally and under the Constitution the defense effort of the U. S. has been the responsibility of the Federal Government; the resultant fiscal load is distributed to the population through the tax structures established by the Congress, and the manpower needs are partially met by Selective Service. Treating civil defense on a different basis represents a very substantial departure in National Defense Policy. It would appear that every departure from this requires its own justification and this must be carefully examined and reevaluated in order to see that efficiency and reliability have not been sacrificed to diffuse authority and fiscal expediency.

Since civil defense, to be effective, must involve a substantial segment of the population, state and local government must be involved to a certain extent, as is the recruiting of local volunteers. Nevertheless, both from the point of view of achieving an effective program, as well as in the interest of reducing the potentially distorting influence of a civil defense program on public attitudes (as discussed in Part IV), we believe that involvement of the civilian population should be held to a minimum and that the Federal role should be a major one.

Fundamentally, we are critical of the concept in which a centrally organized group (the Federal Government) "advises and assists" only partially organized bodies (the Civil Defense organs of State and local governments)

without exercising any real coordination or even emergency control.

2. Cost Sharing Between the Federal Government and State and Local Agencies

We have substantial reservations concerning the extent to which the cost and other efforts involved in shelter construction, stocking, security, maintenance of stocks and instruments, etc., can properly be shared by State, local or private agencies. Maintenance of instruments and other stocks, and shelter management in general, is another facet of the problem of whether civil protection can really be made effective by anything but an essentially all-Federal program. At best, such sharing would result in highly sporadic coverage; at worst, the readiness and usefulness of the shelter space presumed available would be very poor.

We believe that the Federal Government will continue to have difficulty in negotiating with local and state authorities on a cost-sharing shelter-construction program until it is prepared to provide clear guidelines for shelter management and for the handling of post-attack problems. Until responsibilities in the post-attack area are fixed clearly and solutions to the many problems it presents reasonably evident, there is danger that the history of premature commitment which has bedeviled the U.S. civil defense program in the past will be repeated.

We have particular concern about the competition for local and state funds induced by the Incentive Shelter Building Program between educational needs and the need for fallout protection even though the fractional increase in cost may be quite small.

A shift to essentially complete Federal financing of shelter construction would alleviate this competition and hence the source of some local objection to the shelter program. Moreover, such a move would substantially restore the traditional Federal responsibility for defense. Beyond this there is a more fundamental consequence to the adoption of Federal financing: making possible the addition of certain risk-oriented features.

The assumption of the present program that different levels of risk cannot be delineated, with the consequence that differing levels of risk cannot be balanced by varied standards for protective effort, may not continue to be a valid guide. Yet to depart from it when costs are shared would be politically difficult since it would emphasize that different citizens are asked to make

different contributions to their own protection. With a shift to Federal financing the Federal Government regains the option of how to deploy its defense. Since it is the action of the Federal Government that contributes most to defining likely target areas, this option should, in the view of the Panel, be tied to the corresponding responsibility.

The Panel is concerned about the competence of the actual personnel and the effectiveness of the organizational structure that is now managing the civil defense program on the local level. Spot checks carried out by individual Panel Members with local civil defense personnel in exploring their understanding of the Federal program were not encouraging; nor were the data supplied by the OCD which indicated that approximately half of the counties in the U.S. do not have full-time civil defense directors and only one-fourth of the counties are currently participating in some Federal cost-sharing civil defense programs. We consider this evidence, as well as the general argument above, as sufficient reason to suggest that the 50 per cent State - 50 per cent Federal matching program will not meet the need and that something like a 10 per cent - 90 per cent ratio (compare the Federal Highway Program) may be more appropriate.

The actual experience of setting up local shelter management when the identification, marking, and stocking programs are completed should provide a decisive test of the feasibility of relying heavily on local responsibilities in the civil defense program.

3. Private Contributions

We have come to the conclusion that it is a false hope to expect extensive private efforts either in family shelter construction or in reducing the vulnerability of industry and essential services to nuclear attack. (Private group shelter construction by industry may be substantial, however; much will depend on the vigor of the public program.) Private family shelter construction has occurred in less than one-half of one per cent of American homes, and there is little expectation of a substantial increase under present conditions. British experience in World War II showed only minimal compliance with a public campaign for shelter building, even under the immediate threat of German bombs; only the direct government program finally provided substantial bomb protection.

With the notable exception of the telephone companies, very few private funds have been used to harden and diversify essential services. In addition, modern methods of transportation and sale of goods have led to a substantial

reduction in inventories; thus if an attack disrupted transport, local supplies of many commodities would be inadequate in many instances. Increasing inventories is uneconomical and is very unlikely to be undertaken by private industry in the interest of civil defense without Federal subsidy. This observation is symptomatic of the general situation that, as science and technology increase, the complex interdependence of elements of our society and its vulnerability to disruption by attack will grow correspondingly.

Federal Agencies have provided extensive information to various industries on the need for hardening their operations and on procedures for doing it, but little followup information appears to be available to indicate the extent of such private measures.

B. Responsibility Within the Federal Government

1. Coordination and Plans

Perhaps the single most important function of the Federal government is to develop viable plans which will produce, either by developing new programs or by coordinating existing ones, an effective overall civil defense program. Under the recent Executive Orders, the major Departments have specific responsibilities for emergency functions but OCD and OEP carry major responsibility for overall planning and for coordination. Since the only available plan -- "National Plan" -- is far out of date, it is most important that the activation of the Federal planning and coordinating function be given a very high priority and the Panel urgently recommends this.

2. Public Information

Public information and information to states and local governments is a key item in the civil defense picture, since so many of the positive values as well as the risks of civil defense are strongly affected by the nature of the response of the public to information from the Federal Government.

At present public information responsibility is diffuse; improvement is clearly needed to avoid confusion, premature commitment, and at times, outright contradiction. As late as early 1962 some of the information being offered to the public was not only technically obsolete, but also reflected policies such as a preference for evacuation rather than shelter, or primary emphasis on home shelter rather than community shelters, that are not adhered to by this Administration.

We regard the public information program to be extremely important, for it will determine to a large extent the public attitude and response to the entire civil defense program. Moreover, it will determine the extent to which the program will remain controllable. Consequently, we urge that immediate measures be undertaken to improve its coordination and to provide for appropriate policy and technical review. Particular attention should be given to maintaining sets of information for distribution in times of emergency or impending crisis.

3. Research

Most agencies have research assignments in support of civil defense as it relates to their own needs, but in practice only the programs of OCD and to some extent those of other branches of DOD and the AEC have any substantial significance.

In the OCD research program, the Panel concluded that there are too many projects being undertaken by too many contractors, under the supervision and a staff not adequate to properly manage and coordinate the work. Moreover, the proposed program concentrates a disproportionate amount of effort on analytic studies aimed at processing or synthesizing such data as now exist and neglects the need for experimental and theoretical studies aimed at improving the data themselves and providing a better base for future policy and program decisions.

Considering the key role that should be played by the research program, we believe that immediate action should be sought to strengthen this area. The Panel believes that it is unrealistic to assume that a staff of sufficient size and qualifications can be attracted on the time scale required and under the present arrangements to properly supervise and manage the expanding OCD research program. Therefore, it appears to the Panel that the OCD proposal of "expanding the base of the civil defense research program" (which we understand to mean to increase the number of contractors participating in the research program) is a move in the wrong direction. In the view of the Panel, a single organization should be selected to undertake a major part of the research program and also to assume technical management responsibility for a large segment of the entire OCD contract laboratory research effort.

The single organization charged with substantial technical responsibility for the research program should be capable of conducting laboratory and field experiments as well as general research activities; the laboratory

should be directly responsive to requests by the Office of Civil Defense. It should, of course, make full use of other laboratories, both of the government and in the private sector. The Panel believes that the availability of NRDL or one of the AEC laboratories should be explored for this role.

4. The Siting of Military Forces

The Federal Government has full responsibility for the selection of locations for the deployment of U. S. military forces and their selection is a major factor in defining likely target areas. It is therefore natural to inquire whether resiting the U.S. strategic force away from population centers can be carried out as a civil defense measure, and to then compare cost vs. effectiveness of such a measure vs. a fallout shelter program. Such a study has been carried out by WSEG (Report No. 61); however, it was insufficient in scope to treat all of the factors involved.

In addition to the potential saving of lives there are several other matters which must be understood concerning a resiting program aside from the policy question as to how much money should be committed for protection against counterforce attack only. One of these is the obsolescence of such a move in view of expected population shifts. Another problem is that concentration of the U. S. strategic force into the limited area required in a resiting program will ease the AICBM problem of the USSR since the incoming trajectories are then more predictable. The Panel believes that these problems require additional and intensive study. This is an urgent matter in view of the accelerating pace of missile implacement.

C. The Role of the Army

The Panel's study suggests a widespread tendency to fail to recognize the unique and critical role the Army can play in dealing with national disaster. The principal exception to this has been the recent development in the Army of specific civil defense plans alternate to their primary mission. Even though civil defense is of "second priority" within the Army, relative to its combat mission, it is inconceivable to the Panel that in case of nuclear attack against this country, Army units would not actually be used in rescue, medical, sanitation, transportation, decontamination, and other functions. For this reason, the Panel believes that the civil defense policy of the Army should not only extend to planning the civil defense use of each unit, but should also allow for funding in order to purchase stocks specifically for civil defense use. Furthermore, it is obvious that consideration of Army capabilities must be

coordinated in local civil defense planning.

These considerations bring into view a problem we consider to be of transcending importance: this is, to what extent segments of the Army, in particular the Reserves and the National Guard, should be given a first priority responsibility for civil defense, in particular in the now badly neglected field of post-attack rescue and emergency operations.

The limited examination which the Panel has given this problem has led it to recommend prompt study of the possibility of making the Army and National Guard the core of the post-attack rescue activity and perhaps other civil defense functions as well. The use of these units may overcome some of the shortages of trained leadership which is so difficult to obtain through volunteers under peacetime conditions. We consider the Canadian pattern particularly encouraging in this respect.

IX. SUMMARY, CONCLUSIONS, AND RECOMMENDATIONS

The function of civil defense is to increase the probability of survival, both of individuals and of the nation under attack. Even now a war carries the possibility of killing a large portion of the population of the United States, and the magnitude of the threat will probably increase. It is, therefore, easy to argue that an extensive civil defense program to aid in survival should be developed and supported. However, civil defense involves risks and costs as well as limited protection. Hence, judgment on the proper role of civil defense in the total military and political position of the nation must involve the balance among conflicting factors, many of which are neither technical nor military. In its own consideration of civil defense, the Panel has taken as the two principal policy assumptions, that (a) civil defense is to be regarded as insurance against accidental war or against failure of deterrence; and (b) civil defense is not intended to affect the willingness of the U. S. to use nuclear weapons or engage in nuclear war.

The sections which follow set forth (1) the central features of the present civil defense program, (2) the Panel's general observations on the civil defense system, and (3) the Panel's specific conclusions and recommendations.

A. General Characteristics of the Current Civil Defense System

1. Responsibility is jointly shared among the Federal, state and local governments. Operating responsibility is almost entirely in the hands of the latter two, with the Federal Government in an advisory role.

2. Financing is jointly shared in many cases, although the Federal Government is covering the entire cost of some components and local and private funds are expected to cover the cost of other components.

3. The Federal responsibility is delegated to many agencies. OCD has a major share of the funds and responsibility, and has a very active program under way. OEP has a planning and coordinating function and several (14) other departments and agencies have important functions in emergency preparedness.

4. The largest component of the present Federally supported program is a nationwide program of fallout shelters, with emphasis on dual-purpose community shelters.

5. Only a very modest Federal effort and few Federal funds are going into the problems of rescue, fire control, and medical care for disaster areas.

6. The Federal Government has the prime responsibility for developing and dispensing public information. Most of this responsibility is in OCD's hands, but OEP, HEW, Agriculture, and other Federal Agencies have substantial shares. Individual States also have public-information services.

7. Plans for long-range recovery and continuity of government are being developed by OEP, but relatively few Federal funds have yet been committed to this problem area.

8. The Federal Government is relying on private efforts for hardening most critical services and facilities, e.g., electric power, telephone and telegraph communications, natural gas, transportation, etc.

B. General Observations

A civil defense program should be based on a combined political, military and technical evaluation of the scope and character of the threat we face and on a similar evaluation of protective measures. Our present technical knowledge is adequate in many areas, but decidedly inadequate in others. Thus, the short-term effects of nuclear weapons are well understood except for the extent of fire effects from large weapons. But many long-term effects of nuclear war are only dimly perceived, much less understood. Similarly, the feasibility of protecting people from the various effects of blast, fallout and fire is well understood. But in contrast, our knowledge of protective measures against the effects of nuclear war on the environment in which life must continue, and also on the level of recovery that will be possible, is quite unsatisfactory. Without much greater understanding, it is not possible to estimate the level of nuclear attack beyond which recovery would become unlikely. Another very important but poorly understood area is that of the psychological and sociological problems associated with civil defense preparedness, shelter living, and the trauma arising from personal losses and widespread injury, death and destruction which survivors would experience.

It is important to emphasize that our degree of understanding of the consequences of nuclear attack decreases rapidly as the scale of the attack is increased. Although present studies offer useful guidance in evaluating the impact of nuclear attacks that are now possible, these studies have less relevance to the greatly increased attack levels that may become possible

during the present decade. At levels of attack above 10,000 megatons, our ability to survive as a nation may conceivably depend on factors that have received only slight consideration in present studies. While some of these factors are purely scientific or technical, others relate to social and cultural response, and still others to the interactions among casualties, physical destruction, shattered communication and transport systems, extensively disrupted production and economic systems, and possibly altered ecological and biological processes. The net result of these uncertainties is an inability to evaluate with confidence the outcome of high level attacks.

Technically, our greatest deficiency is our lack of understanding of the probable effectiveness of an over-all civil defense system in coping with the endless variety of circumstances and attack patterns in which nuclear war might come. A civil defense system has many parts:

- an over-all disaster plan;
- provisions for warning, command and communications;
- shelters and system for their operation and maintenance;
- equipment, organization and trained teams for rescue, fire control and medical care in disaster areas;
- stockpiles of essential supplies and equipment;
- measures for sanitation and epidemic control;
- measures for continuity of government;
- hardening of key facilities; and
- plans and equipment for the restoration of minimal levels of essential services.

To develop an effective system and to maintain it in a state of readiness during long periods of peace are very difficult tasks. To do these in a manner which minimizes the interference with normal civilian life and which can maintain effectiveness without causing excessive preoccupation with nuclear war is even more difficult. In this connection we take it to be a guiding principle that, at any given level of civil defense expenditure, our aim is to strike the wisest balance between the effectiveness of the civil defense system, the economic costs and distorting effects that a civil defense program may have on the values, both personal and national, that it is created to preserve. Thus our most general recommendation is to urge an expanding and continuing analysis of the systems aspects of civil defense programs, both the present and improved or alternate designs. It is essential that such deliberations consider the changes in the social fabric of the nation that civil defense programs may create, and when such changes are justified, be conscious of the need to provide for the means by which the changes will become understood and accepted by the public.

In connection with both these last recommendations and with the more specific ones which follow, it is important to emphasize that the Panel is not attempting to recommend any particular level of expenditure for civil defense. Its intent is rather to focus on problems of planning, of research, of organization, and of relative priority which in its judgment will be important at any level of expenditure. At a low level of expenditure the primary emphasis will undoubtedly be on research and planning; at a high level problems of organization and of operational efficiency will become dominant.

In the recommendations that follow, attention will be focused on the need to correct imbalances in the present program, e.g., by increasing the relative effort devoted to disaster control and to planning. Neither an increase, nor a decrease in total effort is necessarily implied in these instances, since these areas appear to require greater emphasis regardless of the level of total effort devoted to civil defense.

C. Technical Observations and Recommendations Relating to the Present Programs

1. General Aspects

a. We are concerned that the number of NEAR warning system receivers which would be privately purchased would be very small, if the system were definitely adopted, and that many of such receivers would become inoperative sooner or later unless systematically checked and maintained; consequently, we believe that funding for this system, if adopted, including, purchase, installation, and maintenance of receivers, should become the responsibility of the Federal Government.

b. The need for reliable communications including warning pervades the entire civil defense problem. The Panel is concerned about the adequacy of the presently planned communication network for the post-attack period and recommends a critical review of this entire area.

c. We doubt that the damage assessment systems would provide information in the form needed for a sound evaluation of the trans-attack and post-attack situations and recommend review of the information requirements of the civil defense system.

d. Resiting strategic forces away from cities offers promise of significant casualty reduction under some forms of attack, but does not appear to have been examined in adequate detail. We recommend that both the military and non-military aspects of this problem be subjected to intensive study.

e. Several of the elements of the civil defense system are in themselves highly vulnerable. Among these are the emergency operating centers, the damage assessment centers and the meteorological forecasting network. We recommend that the vulnerability of critical elements of the system be reviewed.

f. The development and dissemination of information to the public about civil defense is not adequately coordinated, and the information itself is often inadequate and frequently does not reflect current technical status or current policy. We recommend that the total public information programs for civil defense and emergency preparedness (all agencies) be reviewed and that its coordination be improved.

2. The Shelter Program

a. The current marking-and-stocking program of fallout shelters is completely justified, in the view of the Panel, and we recommend, that it be pursued, including the gathering of data of sufficient scope to permit re-assessment of protection factors at a later time. The experience gained from this program will be valuable in the development of further shelter policies and programs and we recommend that this "pilot plant" aspect be given great emphasis.

b. The present community fallout shelter program calls for a very large number of trained shelter managers, radiation-monitoring personnel, etc. (the current goal approaches 20 million persons) not supported by Federal funds. The Panel has serious doubts whether the proposed numbers can be obtained and maintained. We recommend that consideration be given to reorienting the shelter management program so that the requirements for trained non-Federal personnel are greatly reduced.

c. In the current marking-and-stocking program, spaces are used whose adequate ventilation assumes continued availability of central electric power. We find this a highly dangerous assumption. The Panel recommends that the shelter marking policies be reviewed in relation to the adequacy of the air supply in the absence of electric power from the central power system.

d. Neither the presently funded stocking-and-marking program nor the incentive-shelter program now before Congress will provide significant fallout protection to the rural population even though this group is the one most likely to be exposed only to fallout. It is recommended that the provision for assistance to the rural population be critically reviewed.

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e. Shelter stocks under the OCD plan, in particular water and medical supplies, are marginal even for a healthy population. Under some plausible attack situations, there is a large population group which will need fallout shelter but which will also be subject to blast and fire casualties as well as to radiation sickness. Under such circumstances the proposed shelter supplies are seriously inadequate. We recommend that the adequacy of the planned stocks for shelter, in particular water and medical supplies, be reviewed immediately. Serious consideration should be given to greatly amplified stocks in areas which are likely to suffer damage from blast and fire.

We further recommend that medical competence be added to the OCD staff without further delay; this should be supported by a medical advisory group.

f. The degree of protection from specified weapons effects offered by shelter of a given construction can be fairly well predicted, but knowledge of medical and behavioral problems is inadequate. As one consequence, it is difficult to judge the relative merits of community shelter as compared to the optimum use of private shelters. We recommend that research in the area of medical and behavioral problems be given increased support.

g. The standard radiation protection factor of 100 that was chosen for the current marking-and-stocking program represents a compromise between many conflicting factors. A lower figure, say 50, would make a much larger number of spaces available without greatly decreasing the life-saving potential under many kinds of attack. In view of the poor reception of the current shelter program by Congress and others, it is recommended that standards for protection factors be reviewed.

3. The Post-Attack Recovery Program

a. The medical problem in the immediate post-attack period is extremely severe since medical services are more vulnerable than the population average while the need for medical assistance is extreme. Current plans on medical stockpiling and medical instruction do not fully reflect the severity of this problem, nor does the extent to which the components of medical care provided by separate agencies are coordinated. We recommend that the development of programs for the provision of medical care and the control of epidemics be coordinated to a much greater degree, and that greatly increased attention be given to the medical problems of disaster areas. We also recommend that responsibility for the distribution

of analgesics, antibiotics, and agents for the control of traumatic casualties be assigned to the Department of Health, Education, and Welfare.

b. Without the support of Federal funding, it is unrealistic to expect implementation of measures for assuring the continuity of essential services in the event of attack, and for preparation of detailed recovery procedures from private industry. We recommend that relatively more study, Federal planning, programming and funding be devoted to the problems of restoration of essential services and of long-range recovery, and also that procedures be established so that all Federal resources can be more effectively used in the post-attack period.

c. The present ratio of funding for the programs associated with fallout shelters to the funding for the other programs aimed at post-attack survival and long-range national recovery is disproportionately high. Essentially no Federal effort is being devoted to disaster control in target areas. We recommend that a relatively larger fraction of funds and effort be committed to the critical areas of rescue, fire control, and medical care in disaster areas with full realization that effective operation in these areas requires equipment and tight command, control and communication as well as trained personnel.

4. Research and Research Management Problems

a. The research program supporting the development of a civil defense system is diffused among many agencies and departments, and is in urgent need of coordination. The largest part of the research program is concentrated in OCD and is itself diffuse. There are too many small projects being carried out by too many contractors. The operating staff is too small to effectively plan, manage, evaluate and coordinate such a program. Despite this situation the Panel believes that the total research program of the OCD needs expansion; in particular, it should be intensified so as to play a more direct and responsible role in OCD operational planning and programming.

b. The responsibility for the execution of a large fraction of the OCD research program should be delegated to a single laboratory. Such a laboratory should be capable of carrying out a substantial part of the required laboratory and field work as well as the directing of the work of other establishments and contractors as needed. This laboratory should be directly responsible to OCD.

c. The following compilation lists the problems that the Panel believes should have high priority in research and development.

(1) Systems analysis of the entire post-attack phase for a number of different attack plans. This would include detailed relationships among essential resources and services and special attention to medical and public health problems.

(2) Basic and applied fire research. Information on ignition and fire spread is inadequate, as is our knowledge of protective measures against fire effects. Population attacks maximizing fire effects deserve special consideration, particularly since the present shelter program is not directed to this threat.

(3) Development of rescue vehicles with radiation protection or of conversion units that would make bulldozers and certain farm equipment suitable for decontamination purposes.

(4) A study of the practicability of building quite inexpensive blast and fire shelters with highway construction equipment, possibly locating such shelters under newly constructed highways.

(5) Extensive field measurements of fallout protection factors using radioactive sources. The possibility should be explored of making measurements at the site of nuclear test explosions.

(6) Further development of reliable and simplified dosimeters and survey instruments.

(7) Intensified study of rate-dependent dose effects in both plants and animals over time periods of interest in fallout protection.

(8) A thorough exploration of the relative merit of a broader utilization of existing structures as opposed to new shelter construction.

(9) Further study of the psychological and medical aspects of shelter living.

(10) Studies of the long-range ecological, biological and genetic effects of heavy nuclear attacks.

(11) More detailed and realistic studies of the problems of economic survival and recovery under varying patterns of attack.

(12) Further study of the relative gain to be made in terms of civil defense objectives by dispersal or hardening of essential facilities and services and by resiting of present missiles and military bases.

(13) Further study of methods of adding low levels of blast and fire protection to fallout shelters incorporated in new buildings.

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ANNEX "A"

Terms of Reference for the Civil Defense Panel of the President's Science Advisory Committee

The Civil Defense Panel of the President's Science Advisory Committee, is being convened to consider technical aspects of civil defense and national recovery programs. It is intended that the Panel review the proposed programs and consider the present state of technical information pertinent to them.

Although the Panel will also consider operational aspects of civil defense and recovery throughout a period beginning with a possible BMEWS or bomb-alarm warning and extending several years after assumed attacks, emphasis will be devoted to problems expected in the first month or two. In these deliberations the attention of the Panel will be directed, but not limited, to the following questions:

1. Considering advancing technology, current intelligence, proposed active offense and defense programs, and the variety of foreseen attack conditions, what effectiveness can be expected of the civil defense and recovery programs now being proposed by the DOD and the OEP? (Note that only that part of OEP planning that relates to the defined time period is relevant.)

2. What is the technical basis of the proposed programs? In particular, and in view of the leadtimes involved, how technically adequate are proposed:

a. Standards for shelter construction and stocking?

b. Provisions for pre-attack warning to State and local authorities, to local communities, and to individuals?

c. Plans for the utilization of shelters, including those for: initial occupancy; habitability, control, etc., during stay in shelters; and determining when to leave shelters?

d. Provisions for emergency support to States and local communities, including such aspects as materiel, transportation, communications, radiation-monitoring and reporting, provisions for decontamination or relocation, mass casualty care, etc.?

e. Preparations for post-attack recovery, including the immediate post-attack phase?

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3. From a technical point of view, is the current Governmental organization adequate to carry out the proposed programs?

4. Are the Governmental research and development programs that support the proposed civil defense and recovery effort adequate and can they be carried out effectively under present organizations?

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ANNEX "B"

Preparedness Programs of Non-Department of Defense Agencies

A. The Program of the Department of Agriculture

The Department of Agriculture is responsible for food production, food management (at the wholesale level), rural fire defense and timber production, rural civil defense information, monitoring of fallout (meat, poultry, fertilizer, soils, crops, and livestock), and for research in these areas.

1. Philosophy and Organization. The USDA program is proceeding on the assumption that the ultimate goal "is to give everyone possible a defense assignment as close to his normal responsibility in peacetime as it is possible to obtain." Based on this philosophy, the entire Department of Agriculture enters the civil defense picture.

2. Food. The assurance of adequate food to support State and local rationing programs is the major Department of Agriculture civil defense responsibility. Data on which food distribution programs can be developed are scanty. USDA proposes to ascertain the level of supply at wholesale level (under its direct supervision in the emergency) and at retail level; on the basis of the data collected, food stockpiles will be established as necessary. Current knowledge suggests that food supplies following an attack would be adequate, however, their distributions would be most uneven. Moreover, it is probable that following an attack, transportation to some areas would be disrupted for days, or even weeks. Consequently, the type, composition distribution, etc., of a national food stockpile are being given detailed consideration.

3. Other Programs. The scope of other activities can be deduced from the following table:

Department of Agriculture FY 1963 Budget Request

Activity	Estimate
Radiological defense training and monitoring	$ 30,000
Food management planning	50,000
Special defense surveys and analysis	30,000
Rural defense information and assistance	60,000
Regional liaison	83,000
National defense planning and coordination	52,000
Defense resources planning	--
Research on food for shelters	--
Total	$305,000

B. The Department of Commerce

The Department of Commerce is responsible for the production resources of the Nation during an emergency (food, power and fuel excluded), the coordination and control of transportation, the provision of resource data to OEP and the Department of Defense, the control of maritime activities, and for the provision of meteorological data and fallout forecasts prior, during, and following an attack. Its principal civil defense activities are concentrated in the Business and Defense Services Administration which is directly responsible for (1) keeping defense production and construction on schedule, (2) civilian production and material resources, (3) war production organization and programs, and (4) the provision of industrial information for emergency decision

The scale of activities associated with these functions is shown in the following table.

Department of Commerce FY 1963 Budget Request

Activity	Estimate
General Administration:	
Transportation Staff (Emergency transportation coordinating functions)	$ 175, 000
Office of Emergency Planning Coordinator	183, 600
Defense Air Transportation Administrator	104, 000
Bureau of the Census	227, 000
Business and Defense Services Administration	1, 888, 200
Maritime Activities	75, 900
Weather Bureau	147, 000
Total	$ 2, 800, 700

C. The Department of Health, Education and Welfare

1. Scope of Responsibility Assignment. The HEW Department has responsibility for the development and implementation (when so ordered) of national emergency plans and programs covering health services, civilian health manpower, health resources, welfare services, and educational programs.

Emergency health services include: medical and dental care; planning, provision and operation of fire aid stations, hospitals, and clinics; detection and control of communicable disease; food and milk sanitation; water supplies; sewage and waste disposal.

Health resources include manpower (including physicians, dentists, registered nurses, etc.), material and facilities required to perform the previously cited functions.

Emergency welfare services include feeding; clothing; lodging; reuniting of separated families and care for unaccompanied children, the aged, and others needing special care.

Education includes the issuance of appropriate guidance and instructional material to schools, colleges, and other educational institutions to incorporate emergency protective measures and civil defense concepts into their programs.

2. Major Program Areas. Major emergency civilian preparedness programs are as follows:

Preparation of the civilian to meet his own health needs when deprived of the services of a physician.

Assistance to States and local communities in the development of their emergency health operational capabilities.

Planning coordinated emergency health programs for Federal Agencies.

a. Medical Self-help Training Program. HEW is initiating a national medical self-help program designed to provide training 300,000 people (one member in each family in the U.S.) in FY 1962, an additional 3,000,000 persons in FY 1963, and ultimately 50,000,000 persons. This program is primarily at the level of first aid.

b. Assistance to States. Since States and local communities will have primary operating responsibilities in the area of emergency public health, assistance to States is an important program. HEW is providing assistance as follows: assignment of a full-time program officer to each State; maintaining (in each State) a public health reserve in a state of readiness through active duty assignments one day per week; and prepositioning of hospitals and emergency supplies in local communities. The latter constitutes the medical stockpile; however, its ultimate dispersion has not yet been effected. About 1900 hospitals were prepositioned in 1961 and approximately 7,000 first aid kits. In 1962 it is anticipated that 1000 additional hospitals will be prepositioned and that back-up supplies will be provided in order to bring them to a 30 day expendable supply capability.

c. Coordination of Federal Health Activities. HEW takes the initiative in the coordination of all health aspects of the programs of the many Federal Agencies. The principal programs in this area are the housing, welfare, and water programs.

d. Funds Requested. The scale and distribution of effort in HEW emergency preparedness programs can be seen in the following table where a summary of FY budget requests is presented.

Department of Health, Education and Welfare FY 1963 Budget Request

Activity	Estimate
Emergency health services	$ 41,445,000
Food and Drug activities	120,000
Emergency welfare services	338,000
Field planning	150,000
Executive direction and coordination	53,000
Total	$42,106,000

D. The Department of the Interior

1. Scope of Responsibility Assignment. The Department of the Interior is responsible for emergency preparedness plans and programs of the Federal Government covering (1) electric power, (2) petroleum and gas, (3) solid fuels, and (4) minerals. These programs include production, distribution (including pipelines), storage, and utilization.

2. Nature of Program. The programs of the Department include planning, encouragement and assistance to industry. Reliance for post-attack operation is placed on standby organizations (power commissions in the 16 power areas and committees for solid fuels in selected areas); these are to assume control and rationing functions during emergencies. Some participate in annual exercises. Training, technical literature, advice, and other assistance are given; however, there is little follow-up to assess compliance with requests or the results of the program.

3. Scale and Distribution of Effort. The relative effort devoted to major programs is suggested by the FY 1963 requests for funds in the major program areas; these are presented in the following table:

Department of the Interior FY 1963 Budget Request

Activity	Estimate
Office of the Secretary	$ 53,500
Water and Power	53,000
Office of Oil and Gas	200,000
Office of Minerals Mobilization	180,000
Total	$ 486,500

E. The Department of Labor

1. Scope of Responsibility Assignment. The Department of Labor is responsible for plans and programs concerning civilian manpower mobilization and the effective utilization of limited manpower resources. These cover: manpower management; priorities for manpower allocation; technical assistance to States for the use of employment services; wage and salary stabilization; worker incentives and protection; assessment of manpower resources; determination of manpower requirements; management-labor relations; and damage assessments to manpower resources.

2. Major Programs. The major activities of the Department of Labor are summarized in the following table along with the FY 1963 fund requests

Department of Labor FY-1963 Budget Request

Activity	Estimate
Emergency management of the labor force	$ 1,000,000
Economic data in support of policy & operations	139,000
Wage stabilization & labor-management relations in an emergency	50,000
Central programming and coordination	96,000
Total	$ 1,285,000

a. Emergency Management of the Labor Force. The Department of Labor feels that "insofar as possible, built-in manpower readiness in those geographic areas which are most likely to feel the manpower impact of a large scale enemy attack" is desirable. Such a built-in readiness is said to be achievable by the pre-assignment in peacetime of civil defense responsibilities to cadres of workers who will immediately function as teams in carrying on survival work. The Department is developing programs for the formation of such cadres, and pilot cadres have been established.

Current emergency management programs provide technical assistance to States and local communities in the development of operating capabilities. Coordination is also provided at State and Regional levels; the latter is important since several Federal Agencies have post-attack operating responsibilities that depend critically on manpower supply and allocation.

b. Provision of Data in Support of Research, Policy, and Operations. The Department has initiated a program for the stockpiling of statistics about the labor force in detail and separating them into categories suitable for emergency management purposes. Such data are essential for damage assessment and emergency planning for all Departments and Agencies having preparedness functions that depend on manpower.

F. Non-Departmental Agencies

The programs of non-departmental agencies, OEP excepted, are relatively small in scale and only the scope of their responsibility assignments and the broad outline of their programs will be considered. These are as follows:

1. The Federal Aviation Agency. The FAA is responsible for programs covering the emergency management of the Nation's civil airports, civil aviation operating facilities, civil aviation services, and non-carrier civil aircraft.

Current programs consist of (1) providing technical guidance and leadership to States, counties, and local communities; (2) development of plans, procedures and technical standards to ensure maximum availability and utilization of aviation resources during an emergency; (3) maintaining liaison with appropriate agencies; and (4) developing shelter policies for civil airport facilities.

2. The Federal Communications Commission. The FCC is responsible for coordinating its activities with those of other agencies and for the protection of its facilities and personnel. Current programs consist of coordination activities except for the selection and training of FCC Reservists.

3. Housing and Home Finance Agency. The HHFA is responsible for the development of emergency plans and programs covering all aspects of lodging or housing and community facilities related thereto.

Current programs seek to provide emergency housing for refugees from attacked or threatened areas, communities facilities (such as water and sewer facilities) for emergency housing, and field organization competent to carry out these programs. Specific projects proposed for 1963 include: (1) Preparation of instructions and guidance for conversion of non-dwelling structures to emergency dwelling use; (2) preparation of specifications and operating instructions for construction and use of trailors for temporary housing; and (3) preparation of other emergency housing plans.

4. Interstate Commerce Commission. The ICC is responsible for emergency plans and programs covering railroad, motor carriers, and inland waterways utilization, operation of the St. Lawrence Seaway, and for the provision of assistance to domestic surface transportation and storage industries.

Principal programs relate to emergency action programming and direction, requirements and capabilities, industries defense, resource evaluation, executive reserve, economic stabilization, research, and interagency coordination. The Commission provides guidance and technical assistance to States relative to their transportation plans.

5. Post Office. The Postmaster General is charged with assisting in the development of a National Emergency Registration System. He procures the necessary materials and conducts training for postal employees which will enable them to operate central postal directories and to assist in the operation of a National Emergency Registration System.

Current programs that are immediately identifiable with this responsibility are conducted by a representative of the National Resources Evaluation Center.

6. Treasury. The Treasury Department is responsible for operating functions concerned indirectly with economic stabilization matters related to monetary, credit, and banking policies.

7. Small Business Administration. "The Small Business Administration is responsible for developing plans for adapting its program to emergency conditions. This includes insuring the continuity of the agencies providing additional functions as dictated by the emergency situation and supporting other agencies as required."

3a

8. Veterans Administration. The Veterans Administration is responsible for integrating into the National Damage Assessment System the data required to develop an estimate of post-attack damage to Veterans Administration personnel and facilities. The Veterans Administration activities are coordinated with other agencies through a representative at the National Resources Evaluation Center.